

DRAINAGE STUDY FOR
PROSPECT ESTATES II
TM2016-03

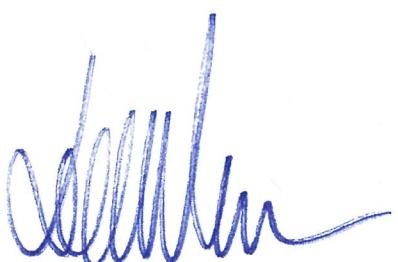
SANTEE, CALIFORNIA

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I. PROJECT DESCRIPTION

This drainage report has been prepared to document the design and calculations for the proposed drainage system associated with the residential development of the Prospect Estates Phase II project in the City of Santee. The project site is 6.8 acres in size and is bounded on the north by vacant land (zoned residential), on the east by vacant land and residential property, on the west by a mobile home development, and on the south by Prospect Avenue and residential uses. The site is mostly undeveloped with one existing house and some small out-buildings, and slopes from south to north at approximately a 5% grade. A portion of the site was partially graded and some storm drain inlets and cleanouts installed for the St. George Church project, approved in 2001.

The proposed design consists of 47 single-family residential units. Vehicular access to the site is provided via Marrokal Lane and Prospect Avenue. Access within the subdivision is via private streets. Parking is allowed on both sides of most streets, as well as in garages and most driveways.

II. HYDROLOGY / HYDRAULICS METHODOLOGY

This drainage system has been designed in general conformance with the City of Santee Department of Public Works “Public Works Standards” (Standards), and the County of San Diego Hydrology Manual (Manual). Drainage basins are less than one square mile, therefore, the Rational Method was utilized to calculate storm runoff. Runoff values for the 2-year, 10-year and 100-year storms were calculated, with the 100-year storm values being used to size the proposed inlets and pipes. Additionally:

- The runoff coefficients were calculated based on each drainage basin’s percentage of impervious cover and the values from the “Runoff Coefficients for Urban Areas”, Table 3-1 of the Manual (Soil Type ‘D’).
- Times of concentration for urban watersheds were calculated using either the “Overland Time of Flow Nomograph” (Figure 3-3 of the Manual), or the trial and error method using the “Gutter and Roadway Discharge – Velocity Chart”, Figure 3-6 of the Manual.
- Times of concentration for natural watersheds were calculated using the “Nomograph for Determination of Time of Concentration for Natural Watersheds”, Figure 3-4 of the Manual.
- The intensities of rainfall were obtained from the "Intensity – Duration Design Chart", Figure 3-1 of the Manual, for each of the selected storm frequencies (2, 10 & 100-year).
- Inlets were sized based on non-routed flow values using Table C, Table D and Table E of the Standards for curb inlets on grade, curb inlets in sumps, and grated inlets in sumps, respectively.
- Manning’s equation was used for pipe design and capacity analysis using routed 100-year storm values.

III. EXISTING CONDITION DRAINAGE

The site slopes from the south to the north, with a minimum elevation of 340 MSL along the northerly property line to 372 MSL in the southeast corner. The entire site drains via surface flow to the northerly property line, where it enters the property on the north. The runoff continues flowing to the north via surface flow to Mission Gorge Road, where it enters the public storm drain system, which flows under Mission Gorge Road and Highway 52 and into the San Diego River.

As shown in Figure 2, the Existing Condition Drainage area contains one on-site basin of 6.85 acres, which generates 7.73 cfs of 100-year storm runoff (See Appendix 1 for hydrological calculations and Table 1 for a hydrology summary). This runoff flows across the ground to the north, where it exits the property to the north.

Also shown in Figure 2 are several off-site basins that contribute flow to the project site. Basin EX-A conveys 0.66 cfs of 100-year storm flow onto the site along the southerly boundary. Basin EX-B conveys 1.80 cfs of 100-year storm flow onto the site along the easterly boundary. Basin EX-C conveys 0.61 cfs of 100-year storm flow onto the site along the easterly boundary. Basin EX-D conveys 0.30 cfs of 100-year storm flow onto the site in the southeast corner.

IV. PROPOSED CONDITION DRAINAGE

The Proposed Condition Drainage has been separated into 9 on-site drainage basins (see Figure 3). Basin A1 collects runoff from the southern portion of the project. This basin comprises 1.04 acres and generates 2.95 cfs of 100-year storm runoff. This runoff is collected in a new curb inlet and conveyed into the new private storm drain system in Street ‘A’, and ultimately discharges into the biofiltration basin in Lot ‘A’.

Basin A2 collects runoff from the central portion of the site, totaling 0.98 acres. This basin generates 3.33 cfs of 100-year storm runoff which is collected in a new curb inlet and conveyed into the new private storm drain system in Street ‘A’. The flow from this basin, together with the flow from Basins A1, is conveyed into the biofiltration area in Lot ‘A’.

Basin A3 collects runoff from the eastern portion of the site and totals 0.94 acres. This basin generates 3.21 cfs of 100-year storm runoff, and also collects the runoff from Basins EX-B and EX-C. Together these flows are captured in a new curb inlet and conveyed into the private storm drain system in Street ‘A’, and ultimately discharge into the biofiltration basin in Lot ‘A’.

Basin A4 collects runoff from the northeast corner of the site, totaling 1.21 acres. This basin generates 3.70 cfs of 100-year storm runoff that is captured in a new curb inlet and conveyed into the private storm drain system in Street ‘D’, and ultimately discharges into the biofiltration basin in Lot ‘A’.

Basin A5 collects runoff from the northerly portion of the site and totals 0.82 acres. This basin generates 2.44 cfs of 100-year storm runoff, and a new curb inlet captures this runoff and

conveys it into the private storm drain system in Street ‘D’, and ultimately discharges into the biofiltration basin in Lot ‘A’.

Basin B1 collects runoff from the westerly portion of the site, totaling 0.78 acres. This basin generates 2.20 cfs of 100-year storm runoff, and when routed with the flow from Basin OFF-1, totals 2.93 cfs of 100-year storm runoff. This combined flow is collected in a new curb inlet and conveyed into the new public storm drain system in Marrokal Lane, and ultimately discharges into the biofiltration basin in Lot ‘A’.

Basin B2 collects runoff from the west side of Marrokal Lane, and totals 0.37 acres. This basin generates 1.98 cfs of 100-year storm runoff, and directs this runoff into a new curb inlet at the northwest corner of the project. The flow is then conveyed into the new public storm drain system in Marrokal Lane, and ultimately discharges into the biofiltration basin in Lot ‘A’.

Basin B3 collects runoff from the northeast side of Marrokal Lane, and totals 0.55 acres. This basin generates 2.16 cfs of 100-year storm runoff, and directs this runoff into a new curb inlet in Marrokal Lane west of Lot ‘A’. The flow is then conveyed into the biofiltration basin in Lot ‘A’.

Basin C1 comprises the biofiltration area, and totals 0.13 acres. This basin generates 0.15 cfs of 100-year storm runoff, and together with the runoff from the other proposed condition basins, is captured in the underdrains within the biofiltration area.

Basin OFF-1 comprises the same area as Existing Condition Drainage Basin EX-A, but in the Proposed Condition is entirely impervious. This basin generates 0.90 cfs of 100-year storm runoff that flows in the northerly gutter of Prospect Avenue into Basin B1.

Basin OFF-2 comprises a similar area as Existing Condition Drainage Basin EX-D, but is a little larger due to the proposed inlet location. This basin generates 0.46 cfs of 100-year storm runoff that flows in the gutter into Basin B2.

As shown in Figure 3, the Proposed Condition Drainage conveys the project runoff into the biofiltration area in Lot ‘A’ in the northwest corner of the site. This biofiltration area will filter the runoff through the soil matrix and be collected in the underdrains. The grated inlet structure will collect the filtered runoff from the underdrains, and will also be utilized as an overflow in the event of system failure or flows above the 100-year storm. The runoff will be conveyed into the existing 36” storm drain in Marrokal Lane, which ties into the storm drain system in Mission Gorge Road, and ultimately empties into the San Diego River. See the Storm Water Quality Management Plan (SWQMP) for more information on the proposed storm water BMP’s.

V. CONCLUSIONS

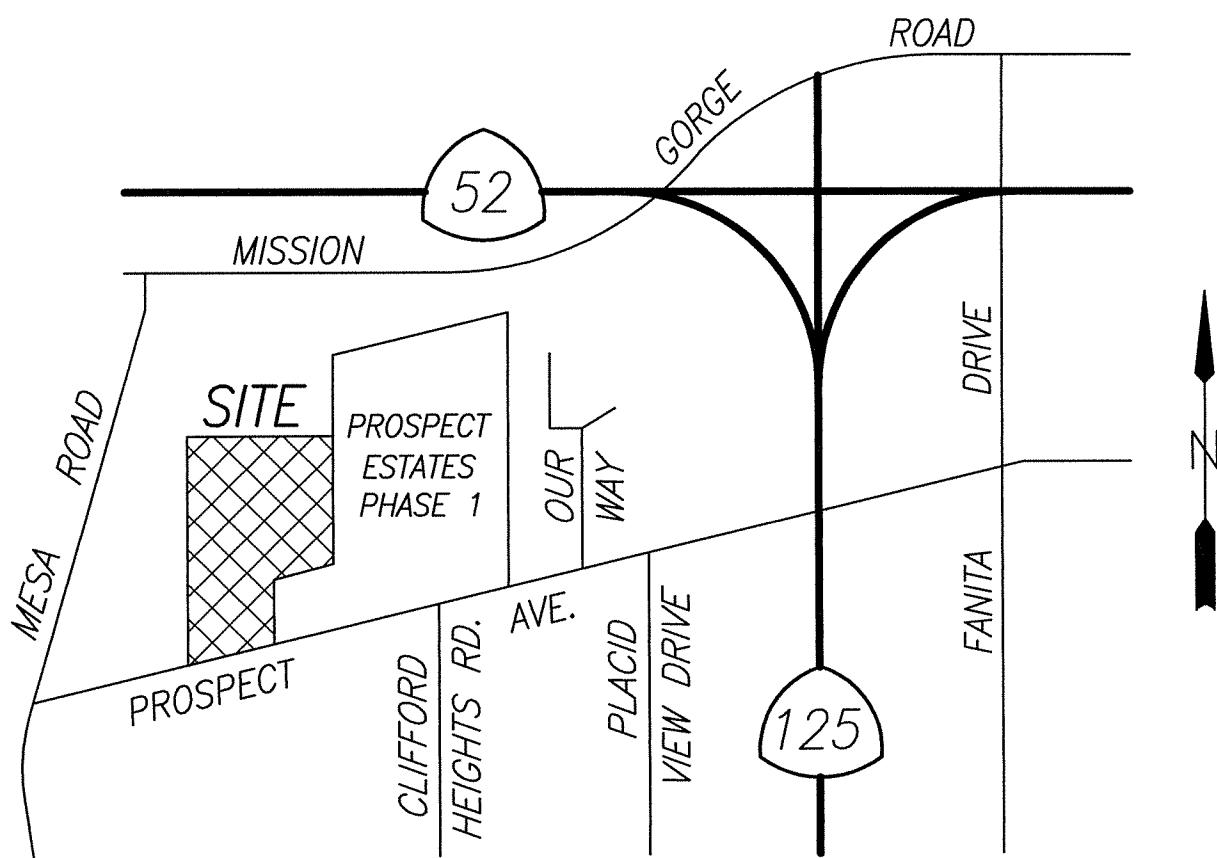
As summarized in Table 1, the Proposed Condition drainage totals 14.87 cfs of routed 100-year storm runoff, compared to the Existing Condition value of 7.73 cfs for the project site. This equates to a difference 7.14 cfs. As described in the project SWQMP, this project is not required to provide hydromodification since it empties into a hardened conveyance system that empties into the San Diego River, an exempt system. However, the biofiltration basin will detain flows so

that the flow leaving the basin in the proposed condition is equal to or less than the existing flow value of 7.73 cfs.

As previously described, off-site flows that come on to the property from the south will be adequately handled with the proposed drainage system. Off-site drainage facilities are not required to deal with the off-site flows identified. As shown in Appendix 2, the existing 36" storm drain in Marrokal Lane has adequate capacity to handle the proposed condition runoff value from this project.

The on-site drainage facilities (storm drain inlets, cleanouts, and pipes) proposed with this subdivision, other than those located in Marrokal Lane, will be private and maintained by the HOA. The project SWQMP will provide the maintenance requirements for the biofiltration facility so that the HOA will be properly informed of their responsibilities. The existing storm drain in Marrokal Lane is public, and the proposed storm drain facilities in Marrokal Lane are proposed to be public, and these existing and proposed storm drain facilities in Marrokal Lane will be maintained by the City of Santee.

FIGURE 1



VICINITY MAP
NO SCALE

TABLE 1 - HYDROLOGY SUMMARY

EXISTING CONDITION													
BASIN	AREA	C	L	S (%)	Tc	I ₂	I ₁₀	I ₁₀₀	Q ₂	Q ₁₀	Q ₁₀₀	COMMENTS	
NUMBER	(acres)		(ft.)	Heff (min.)	(in/hr)	(in/hr)	(in/hr)	(in/hr)	(cfs)	(cfs)	(cfs)		
EX-1	6.85	0.36	900	3.30	14.85	1.44	2.22	3.13	3.54	5.47	7.73	Surface flow to northerly neighbors	
OFF-SITE BASINS													
EX-A	0.20	0.73	360	1.00	8.43	2.07	3.20	4.51	0.30	0.47	0.66	Surface flow from north side of Prospect Avenue	
EX-B	0.31	0.81	215	4.70	4.10	3.29	5.09	7.19	0.83	1.28	1.80	Surface flow from properties to the east	
EX-C	0.18	0.65	230	5.20	6.74	2.39	3.69	5.22	0.28	0.43	0.61	Surface flow from properties to the east	
EX-D	0.06	0.85	90	0.50	5.64	2.68	4.14	5.85	0.14	0.21	0.30	Surface flow from north side of Prospect Avenue	
ON-SITE BASINS													
BASIN	AREA	C	L	Slope (ft.)	% (min.)	Tc (in/hr)	I ₂ (in/hr)	I ₁₀ (in/hr)	I ₁₀₀ (in/hr)	Q ₂ (cfs)	Q ₁₀ (cfs)	Q ₁₀₀ (cfs)	COMMENTS
NUMBER	(acres)												
A1	1.04	0.68	440	3.10	9.54	1.91	2.95	4.17	1.35	2.09	2.95	Gutter flow into curb inlet	
A2	0.98	0.68	425	5.20	7.20	2.29	3.54	5.00	1.53	2.36	3.33	Gutter flow into curb inlet	
A3	0.94	0.66	405	6.30	6.82	2.37	3.67	5.18	1.47	2.27	3.21	Gutter flow into curb inlet	
A4	1.21	0.69	360	2.00	8.67	2.03	3.14	4.43	1.70	2.62	3.70	Gutter flow into curb inlet	
A5	0.82	0.69	230	1.50	9.03	1.98	3.06	4.32	1.12	1.73	2.44	Gutter flow into curb inlet	
B1	0.78	0.69	625	2.80	9.85	1.87	2.89	4.08	1.01	1.56	2.20	Gutter flow into curb inlet	
B2	0.37	0.90	680	3.80	5.51	2.72	4.21	5.94	0.91	1.40	1.98	Gutter flow into curb inlet	
B3	0.55	0.75	465	3.00	6.69	2.40	3.71	5.24	0.99	1.53	2.16	Gutter flow into curb inlet	
C1	0.13	0.35	85	0.50	13.20	1.55	2.39	3.38	0.07	0.11	0.15	Surface flow into grated inlet	
TOTAL	6.85									10.64	16.45	23.22	
Proposed Condition Q ₁₀₀ minus Existing Condition Q ₁₀₀ =													7.14 CRS increase during 100-year storm
Proposed Condition Q ₁₀₀ =													14.87 Routed 100-year storm flow
OFF-SITE BASINS													
BASIN	AREA	C	L	Slope (ft.)	% (min.)	Tc (in/hr)	I ₂ (in/hr)	I ₁₀ (in/hr)	I ₁₀₀ (in/hr)	Q ₂ (cfs)	Q ₁₀ (cfs)	Q ₁₀₀ (cfs)	COMMENTS
NUMBER	(acres)												
OFF-1	0.20	0.90	360	1.00	7.16	2.30	3.55	5.02	0.41	0.64	0.90	Surface flow from north side of Prospect Avenue	
OFF-2	0.08	0.90	125	2.40	5.00	2.90	4.48	6.32	0.21	0.32	0.46	Surface flow into curb inlet	

TABLE 2

CURB INLET SIZING SUMMARY

Basin	Q100 (cfs)	Street slope (%)	Flow depth in gutter (ft)	Inlet Condition	Inlet Sizing Equation	a	y	Cw	L	Inlet Description
A1	2.95	7.0	0.24	on-grade	$L=Q100/.7(a+y)^{1.5}$	0.33	0.24	-	10'	11' Type 'B-1' curb inlet
A2	3.33	5.0	0.27	on-grade	$L=Q100/.7(a+y)^{1.5}$	0.33	0.27	-	11'	12' Type 'B-1' curb inlet
A3	5.12	5.0	0.31	on-grade	$L=Q100/.7(a+y)^{1.5}$	0.33	0.31	-	15'	16' Type 'B-1' curb inlet
A4	3.70	1.0	0.34	sump	$L=Q100/Cw \times (y)^{1.5}$	-	0.5	3.0	4'	5' Type 'B' curb inlet
A5	2.44	1.0	0.3	sump	$L=Q100/Cw \times (y)^{1.5}$	-	0.5	3.0	3'	5' Type 'B' curb inlet
B1	2.93	4.0	0.26	on-grade	$L=Q100/.7(a+y)^{1.5}$	0.33	0.26	-	10'	11' Type 'B-1' curb inlet
B2	1.98	3.3	0.24	on-grade	$L=Q100/.7(a+y)^{1.5}$	0.33	0.24	-	7'	8' Type 'B-1' curb inlet
B3	2.16	3.3	0.24	on-grade	$L=Q100/.7(a+y)^{1.5}$	0.33	0.24	-	8'	9' Type 'B-1' curb inlet

APPENDIX 1

HYDROLOGICAL CALCULATIONS

PROSPECT ESTATES - PHASE II
HYDROLOGY CALCS

EXISTING CONDITION

BASIN EX-1

$$\text{AREA} = 297,289 \text{ SF} = \underline{6.82 \text{ AC}}$$

$$\text{IMPERV. SURFACE} = 2686 \text{ SF} (29.0\%)$$

$$\text{PERK. SURFACE} = 294603 \text{ SF} (99.1\%)$$

$$C' = 0.9(0.09) + 0.35(0.991) = \underline{0.36}$$

$$L = \underline{900'}$$

$$S = 30/900 = \underline{3.3\text{do}}$$

$$T_c = T_i + T_f$$

$$T_i = 10.1 \text{ min}, L_m = 100' (\text{TABLE 3-2})$$

$$T_f = \frac{[11.9 \frac{L^3}{\Delta E}]^{.385}}{30} \times 60 \quad L = 900 - 100/5280 = 0.15 \text{ mi} \\ \Delta E = 30'$$

$$T_f = \frac{[11.9 (.15)]^{37.385}}{30} \times 60 = 4.75 \text{ min.}$$

$$T_c = 10.1 + 4.75 = \underline{14.85 \text{ min.}}$$

$$I_2 = 7.44(1.1)/14.85 = \underline{1.44 \text{ in/HR}}$$

$$I_{10} = 7.44(1.7)/14.85 = \underline{2.22 \text{ in/HR}}$$

$$I_{100} = 7.44(2.9)/14.85 = \underline{3.13 \text{ in/HR}}$$

$$Q_2 = CAI_2 = (0.36)(6.82)(1.44) = \underline{3.54 \text{ cfs}}$$

$$Q_{10} = CAI_{10} = (0.36)(6.82)(2.22) = \underline{5.47 \text{ cfs}}$$

$$Q_{100} = CAI_{100} = (0.36)(6.82)(3.13) = \underline{7.73 \text{ cfs}}$$

BASIN EX-A

$$\text{AREA} = 8,745 \text{ SF} = 0.20 \text{ AC}$$

$$\text{IMPERV. SURFACE} = 5,973 \text{ SF} (68.3\%)$$

$$\text{PERV. SURFACE} = 2,772 \text{ SF} (31.7\%)$$

$$C = 0.9 (.683) + 0.35 (.317) = \underline{\underline{0.73}}$$

$$L = 360'$$

$$S = 3.5 / 360 = 1.0\%$$

$$T_C = T_i + T_f$$

$$T_i = 4.7 \text{ min.}, L_m = 65' \text{ (TABLE 3-2)}$$

$$T_f = \left[\frac{11.9 L^3}{\Delta E} \right]^{0.385} \times 60 \quad L = \frac{360 - 65}{5280} = 0.06 \text{ mi.}$$

$$= \left[\frac{11.9 (0.06)^3}{3.5} \right]^{0.385} \times 60$$

$$T_f = 3.73 \text{ min.}$$

$$T_C = 4.70 + 3.73 = \underline{\underline{8.43 \text{ min.}}}$$

$$I_2 = 2.44(1.1) 8.43^{-0.645} = \underline{\underline{2.07 \text{ in/hr}}}$$

$$I_{10} = 2.44(1.7) 8.43^{-0.645} = \underline{\underline{3.20 \text{ in/hr}}}$$

$$I_{100} = 2.44(2.9) 8.43^{-0.645} = \underline{\underline{4.51 \text{ in/hr}}}$$

$$Q_2 = CAI_2 = (0.73)(0.20)(2.07) = \underline{\underline{0.30 \text{ cfs}}}$$

$$Q_10 = CAI_{10} = (0.73)(0.20)(3.20) = \underline{\underline{0.47 \text{ cfs}}}$$

$$Q_{100} = CAI_{100} = (0.73)(0.20)(4.51) = \underline{\underline{0.66 \text{ cfs}}}$$

BASIN EX-B

$$\text{AREA} = 13, \text{ SH/SF} = \underline{0.31 \text{ AC}}$$

$$\begin{aligned}\text{IMPERV. SURF.} &= 11,334 \text{ SF } (83.9\%) \\ \text{PERV. SURF.} &= 2,177 \text{ SF } (16.1\%)\end{aligned}$$

$$C = 0.9(0.839) + 0.35(0.161) = \underline{0.81}$$

$$\underline{L = 215'}$$

$$\underline{S = 10/215 = 4.7\%}$$

$$T_c = T_i + T_f$$

$$T_i = 3.4 \text{ min.}, L_m = 95' \text{ (TABLE 3-2)}$$

$$\begin{aligned}T_f &= \left[\frac{11.9 L^3}{\Delta E} \right]^{.385} \times 60 \quad L = \frac{215 - 95}{5280} = 0.02 \text{ min}' \\ &= \left[\frac{11.9 (0.02)^3}{10} \right]^{.385} \times 60\end{aligned}$$

$$T_f = 0.70 \text{ min.}$$

$$T_c = 3.4 + 0.7 = \underline{4.10 \text{ min.}}$$

$$\underline{I_2 = 7.44(1.1) 4.10^{-0.645} = 3.29 \text{ in/hr}}$$

$$\underline{I_{10} = 7.44(1.2) 4.10^{-0.645} = 5.09 \text{ in/hr}}$$

$$\underline{I_{100} = 7.44(2.4) 4.10^{-0.645} = 7.19 \text{ in/hr}}$$

$$\underline{Q_2 = CAI_2 = (0.81)(0.31)(3.29) = 0.83 \text{ cfs}}$$

$$\underline{Q_{10} = CAI_{10} = (0.81)(0.31)(5.09) = 1.28 \text{ cfs}}$$

$$\underline{Q_{100} = CAI_{100} = (0.81)(0.31)(7.19) = 1.80 \text{ cfs}}$$

BASIN EX-C

$$\text{AREA} = 7,977 \text{ SF} = \underline{0.18 \text{ AC}}$$

$$\begin{array}{l} \text{IMP. SURF.} = 4,318 \text{ SF} \\ \text{PERV. SURF.} = 3,659 \text{ SF} \end{array} \quad \begin{array}{l} (54.1\%) \\ (45.9\%) \end{array}$$

$$C = 0.9(541) + 0.35(459) = \underline{0.65}$$

$$L = \underline{230'}$$

$$S = \underline{12/230 = 5.2\%}$$

$$T_C = T_i + T_f$$

$$T_i = 5.7 \text{ min., } L = 100' \text{ (TABLE 3-2)}$$

$$T_f = \left[\frac{11.9 L^3}{\Delta E} \right]^{.385} \times 60 \quad L = \frac{230 - 100}{5280} = 0.03 \text{ mi}'$$

$$= \left[\frac{11.9 (0.03)^3}{12} \right]^{.385} \times 60 \quad \Delta E = 12$$

$$T_f = 1.04 \text{ min.}$$

$$T_C = 5.7 + 1.04 = \underline{6.74 \text{ min.}}$$

$$I_2 = 2.44(1.1)6.74^{-0.65} = \underline{2.39 \text{ in/HR}}$$

$$I_{10} = 2.44(1.1)6.74^{-0.65} = \underline{3.69 \text{ in/HR}}$$

$$I_{100} = 2.44(2.4)6.74^{-0.65} = \underline{5.22 \text{ in/HR}}$$

$$Q_2 = CAI_2 = (0.65)(0.18)(2.39) = \underline{0.28 \text{ cfs}}$$

$$Q_{10} = CAI_{10} = (0.65)(0.18)(3.69) = \underline{0.43 \text{ cfs}}$$

$$Q_{100} = CAI_{100} = (0.65)(0.18)(5.22) = \underline{0.61 \text{ cfs}}$$

BASIN EX-D

$$\underline{\text{AREA}} = 2,707 \text{ SF} = \underline{0.06 \text{ AC}}$$

$$\text{IMP. SURF.} = 2,442 \text{ SF (90.2\%)}$$

$$\text{PERV. SURF.} = 265 \text{ SF (9.8\%)}$$

$$\underline{c'} = 0.9(0.902) + 0.35(0.098) = \underline{0.85}$$

$$\underline{L} = \underline{90'}$$

$$\underline{s} = \underline{0.50\%}$$

$$T_c = T_i + T_f$$

$$T_f = 4.7 \text{ MIN, } L_m = 50' \text{ (TABLE 3-2)}$$

$$T_f = \frac{[1.9L^3]^{.385}}{\Delta E} \times 60 \quad L = 90 - 50 / 280 = 0.008 \text{ mi.} \\ \Delta E = 0.30'$$

$$T_f = \frac{[1.9(0.008)]^{.385}}{.30} \times 60 = 0.94 \text{ min.}$$

$$\underline{T_c} = 4.7 + 0.94 = \underline{5.64 \text{ min.}}$$

$$\underline{I_2} = 2.44(1.1)5.64^{-0.645} = \underline{2.68 \text{ in/HR}}$$

$$\underline{I_{10}} = 2.44(1.7)5.64^{-0.645} = \underline{4.14 \text{ in/HR}}$$

$$\underline{I_{100}} = 2.44(2.4)5.64^{-0.645} = \underline{5.85 \text{ in/HR}}$$

$$\underline{Q_2} = CAI_2 = (0.85)(0.06)(2.68) = \underline{0.14 \text{ cfs}}$$

$$\underline{Q_{10}} = CAI_{10} = (0.85)(0.06)(4.14) = \underline{0.21 \text{ cfs}}$$

$$\underline{Q_{100}} = CAI_{100} = (0.85)(0.06)(5.85) = \underline{0.30 \text{ cfs}}$$

PROPOSED CONDITION

BASIN A1

$$\underline{\text{AREA}} = 45,222 \text{ SF} = \underline{1.04 \text{ AC}}$$

$$\text{IMPERV. SURF} = 27,171 \text{ SF} (60.0\%)$$

$$\text{PERV. SURF} = 18,051 \text{ SF} (40.0\%)$$

$$\underline{C'} = 0.9(0.60) + 0.35(0.40) = \underline{0.68}$$

$$\underline{L = 440'}$$

$$\underline{S = 3.1\%}$$

$$T_c = T_i + T_f$$

$$T_i = 7.9 \text{ min.}, L_m = 95' \text{ (TABLE 3-2)}$$

$$T_f \rightarrow \text{ASSUME } V_{10} = 3.5 \text{ FPS}$$

$$T_f = \frac{440 - 95}{3.5 \times 60} = 1.64 \text{ min.}$$

$$T_c = 7.9 + 1.64 = 9.54 \text{ min.}$$

$$I_{10} = 7.44(1.7)9.54^{\frac{6.95}{60}} = 2.95 \text{ in/HR}$$

$$Q_{10} = CAI_{10} = (0.68)(1.04)(2.95) = 2.09 \text{ CFS}$$

\rightarrow FROM FIG. 3-6 $\rightarrow V_{10} = 3.5 \text{ FPS} \checkmark$

$$\underline{T_c = 9.54 \text{ min.}}$$

$$\underline{I_2 = 7.44(1.1)9.54^{\frac{6.95}{60}} = 1.91 \text{ in/HR}}$$

$$\underline{I_{10} = 7.44(1.7)9.54^{\frac{6.95}{60}} = 2.95 \text{ in/HR}}$$

$$\underline{I_{100} = 7.44(2.4)9.54^{\frac{6.95}{60}} = 4.17 \text{ in/HR}}$$

$$\underline{Q_2 = CAI_2 = (0.68)(1.04)(1.91) = 1.35 \text{ CFS}}$$

$$\underline{Q_{10} = CAI_{10} = (0.68)(1.04)(2.95) = 2.09 \text{ CFS}}$$

$$\underline{Q_{100} = CAI_{100} = (0.68)(1.04)(4.17) = 2.95 \text{ CFS}}$$

BASIN A2

$$\text{AREA} = 42,578 \text{ SF} = \underline{0.98 \text{ AC}}$$

$$\text{IMP. SURF.} = 25,513 \text{ SF} (59.9\%)$$

$$\text{PERV. SURF.} = 17,065 \text{ SF} (40.1\%)$$

$$\bar{C} = 0.9(0.599) + 0.35(0.401) = \underline{0.68}$$

$$\underline{L = 425'}$$

$$\underline{S = 5.2\%}$$

$$\underline{T_c = T_i + T_f}$$

$$T_i = 6.0 \text{ min.}, L_m = 100' (\text{TABLE 3-2})$$

$$T_f \rightarrow \text{Assume } V_{f0} = 4.5 \text{ SFOS}$$

$$T_f = \frac{425 - 100}{4.5 \times 60} = 1.20 \text{ min.}$$

$$T_c = 6.0 + 1.20 = 7.20 \text{ min.}$$

$$I_{10} = 7.44(1.7)7.20^{-0.645} = 3.54 \text{ in/HR}$$

$$Q_{10} = CA I_{10} = (0.68)(0.98)(3.54) = 2.36 \text{ CFS}$$

FROM FIG. 3-6 $\rightarrow V_{f0} = 4.5 \text{ SFOS} \checkmark$

$$\underline{T_c = 7.20 \text{ min.}}$$

$$I_2 = 7.44(1.1)7.20^{-0.645} = \underline{2.29 \text{ in/HR}}$$

$$I_{10} = 7.44(1.7)7.20^{-0.645} = \underline{3.54 \text{ in/HR}}$$

$$I_{100} = 7.44(2.4)7.20^{-0.645} = \underline{5.00 \text{ in/HR}}$$

$$Q_2 = CA I_2 = (0.68)(0.98)(2.29) = \underline{1.53 \text{ CFS}}$$

$$Q_{10} = CA I_{10} = (0.68)(0.98)(3.54) = \underline{2.36 \text{ CFS}}$$

$$Q_{100} = CA I_{100} = (0.68)(0.98)(5.00) = \underline{3.33 \text{ CFS}}$$

BASIN AB

$$\text{AREA} = 40,902 \text{ SF} = 0.94 \text{ AC}$$

$$\text{IMP. AREA} = 21,994 \text{ SF} (53.8\%)$$

$$\text{PERV. AREA} = 18,908 \text{ SF} (46.2\%)$$

$$C' = 0.9(538) + 0.35(462) = 0.66$$

$$L = 405'$$

$$S = 6.3\%$$

$$T_C = T_i + T_f$$

$$T_i = 5.8 \text{ min.}, L_m = 100' (\text{TABLE 3-2})$$

$$T_f \rightarrow \text{Assume } V_0 = 5.0 \text{ FPS}$$

$$T_f = \frac{405 - 100}{5.0 \times 60} = 1.02 \text{ min.}$$

$$T_C = 5.8 + 1.02 = 6.82 \text{ min.}$$

$$I_{10} = 7.44(1.1)6.82^{-0.65} = 3.67 \text{ in/HR}$$

$$Q_{10} = CAI_{10} = (0.66)(0.94)(3.67) = 2.27 \text{ cfs}$$

FROM FIG. 3-6 $\rightarrow V_0 = 5.0 \text{ FPS}$ ✓

$$T_C = 6.82 \text{ min.}$$

$$I_2 = 7.44(1.1)6.82^{-0.65} = 2.37 \text{ in/HR}$$

$$I_{10} = 7.44(1.1)6.82^{-0.65} = 3.67 \text{ in/HR}$$

$$I_{100} = 7.44(2.4)6.82^{-0.65} = 5.18 \text{ in/HR}$$

$$Q_2 = CAI_2 = (0.66)(0.94)(2.37) = 1.47 \text{ cfs}$$

$$Q_{10} = CAI_{10} = (0.66)(0.94)(3.67) = 2.27 \text{ cfs}$$

$$Q_{100} = CAI_{100} = (0.66)(0.94)(5.18) = 3.21 \text{ cfs}$$

BASIN A4

$$\text{AREA} = 52,705 \text{ SF} = \underline{1.21 \text{ AC}}$$

$$\text{IMP. SURF.} = 31,654 \text{ SF (60.1\%)}$$

$$\text{PERV. SURF.} = 21,051 \text{ SF (39.9\%)}$$

$$C' = 0.9(1.601) + 0.35(1.399) = \underline{0.69}$$

$$L = 305'$$

$$S = 2.0\%$$

$$T_c = T_r + T_f$$

$$T_r = 7.5 \text{ min., } L_m = 80' \text{ (TABLE 3-2)}$$

$$T_f \rightarrow \text{Assume } V_{10} = 3.2 \text{ FPS}$$

$$T_f = \frac{305 - 80}{3.2 \times 60} = 1.17 \text{ min.}$$

$$T_c = 7.5 + 1.17 = 8.67 \text{ min.}$$

$$I_{10} = 7.44(1.7)8.67^{-0.645} = 3.14 \text{ in/HR}$$

$$Q_{10} = CAI_{10} = (0.69)(1.21)(3.14) = 2.62 \text{ CFS}$$

$$\text{FROM FIG. 3-6} \rightarrow V_{10} = 3.2 \text{ FPS} \checkmark$$

$$T_c = \underline{8.67 \text{ min.}}$$

$$I_2 = 7.44(1.1)8.67^{-0.645} = \underline{2.03 \text{ in/HR}}$$

$$I_{10} = 7.44(1.7)8.67^{-0.645} = \underline{3.14 \text{ in/HR}}$$

$$I_{100} = 7.44(2.4)8.67^{-0.645} = \underline{4.43 \text{ in/HR}}$$

$$Q_2 = CAI_2 = (0.69)(1.21)(2.03) = \underline{1.70 \text{ CFS}}$$

$$Q_{10} = CAI_{10} = (0.69)(1.21)(3.14) = \underline{2.62 \text{ CFS}}$$

$$Q_{100} = CAI_{100} = (0.69)(1.21)(4.43) = \underline{3.70 \text{ CFS}}$$

BASIN A5

$$\text{AREA} = 35,728 \text{ SF} = 0.82 \text{ AC}$$

$$\text{IMP. SURF.} = 21,698 \text{ SF} (60.7\%)$$

$$\text{PERV. SURF.} = 14,030 \text{ SF} (39.3\%)$$

$$\bar{C} = 0.9(0.607) + 0.35(0.393) = 0.69$$

$$L = 230'$$

$$S = 1.5\%$$

$$T_c = T_i + T_f$$

$$T_i = 8.0 \text{ min.}, L_m = 75' (\text{TABLE 3-2})$$

$$T_f \rightarrow \text{ASSUME } V_{f0} = 2.5 \text{ FPS}$$

$$T_f = \frac{230 - 75}{2.5 \times 60} = 1.03 \text{ min.}$$

$$T_c = 8.0 + 1.03 = 9.03 \text{ min.}$$

$$I_{10} = 7.44(1.7)^{-0.695} = 3.06 \text{ in/HR}$$

$$Q_{10} = CAI_{10} = (0.69)(0.82)(3.06) = 1.73 \text{ cfs}$$

FROM FIG. 3-6 $\rightarrow V_{f0} = 2.5 \text{ FPS}$ ✓

$$T_c = 9.03 \text{ min.}$$

$$I_2 = 7.44(1.1)^{-0.695} = 1.98 \text{ in/HR}$$

$$I_{10} = 7.44(1.7)^{-0.695} = 3.06 \text{ in/HR}$$

$$I_{100} = 7.44(2.4)^{-0.695} = 4.32 \text{ in/HR}$$

$$Q_2 = CAI_2 = (0.69)(0.82)(1.98) = 1.12 \text{ cfs}$$

$$Q_{10} = CAI_{10} = (0.69)(0.82)(3.06) = 1.73 \text{ cfs}$$

$$Q_{100} = CAI_{100} = (0.69)(0.82)(4.32) = 2.44 \text{ cfs}$$

BASIN B1

$$\underline{\text{AREA}} = 34,237 \text{ SF} = \underline{0.78 \text{ AC}}$$

$$\text{IMP. AREA} = 21,594 \text{ SF} (63.1\%)$$

$$\text{PERV. AREA} = 12,643 \text{ SF} (36.9\%)$$

$$\underline{C'} = 0.9(0.631) + 0.35(0.369) = \underline{0.69}$$

$$\underline{L} = 625'$$

$$\underline{S} = 2.8^{\circ}$$

$$T_c = T_i + T_f$$

$$T_i = 7.3 \text{ min}, L_m = 90' (\text{TABLE 3-2})$$

$$T_f \rightarrow \text{ASSUME } V_{f0} = 3.5 \text{ FPS}$$

$$T_f = \frac{625 - 90}{3.5 \times 60} = 2.55 \text{ MIN.}$$

$$T_c = 7.3 + 2.55 = 9.85 \text{ MIN.}$$

$$I_0 = 7.44(1.7)9.85^{-0.695} = 2.89 \text{ in/HR}$$

$$Q_{10} = CAI_{10} = (0.69)(0.78)(2.89) = 1.56 \text{ cfs}$$

$$\text{FROM FIG. 3-6} \rightarrow V_0 = 3.5 \text{ FPS} \checkmark$$

$$\underline{T_c = 9.85 \text{ MIN.}}$$

$$\underline{I_2 = 7.44(1.7)9.85^{-0.695} = 1.87 \text{ in/HR}}$$

$$\underline{I_{10} = 7.44(1.7)9.85^{-0.695} = 2.89 \text{ in/HR}}$$

$$\underline{I_{100} = 7.44(2.4)9.85^{-0.695} = 4.08 \text{ in/HR}}$$

$$Q_2 = CAI_2 = 0.69(0.78)(1.87) = \underline{1.01 \text{ cfs}}$$

$$Q_{10} = CAI_{10} = (0.69)(0.78)(2.89) = \underline{1.56 \text{ cfs}}$$

$$Q_{100} = CAI_{100} = (0.69)(0.78)(4.08) = \underline{2.20 \text{ cfs}}$$

BASIN B2

$$\text{AREA} = 15,931 \text{ SF} = 0.37 \text{ AC}$$

$$C' = 0.90 \text{ (ALL IMPERVIOUS)}$$

$$L = 680'$$

$$S = 3.8\%$$

$$T_c = T_i + T_f$$

$$T_i = 2.9 \text{ min}, L_m = 84' \text{ (TABLE 3-2)}$$

$$T_f \rightarrow \text{ASSUME } V_{f0} = 3.8 \text{ FPS}$$

$$T_f = \frac{680 - 84}{3.8 \times 60} = 2.61 \text{ MIN.}$$

$$T_c = 2.9 + 2.61 = 5.51 \text{ min.}$$

$$I_{00} = 7.44(1.7)5.51^{-0.645} = 4.21 \text{ in/HR}$$

$$Q_{10} = CAI_{10} = (0.9)(0.37)(4.21) = 1.40 \text{ cfs}$$

$$\text{FROM FIG. 3-6} \rightarrow V_{f0} = 3.8 \text{ FPS} \checkmark$$

$$T_c = 5.60 \text{ min.}$$

$$I_2 = 7.44(1.1)5.51^{-0.645} = 2.72 \text{ in/HR}$$

$$I_{10} = 7.44(1.7)5.51^{-0.645} = 4.21 \text{ in/HR}$$

$$I_{100} = 7.44(2.4)5.51^{-0.645} = 5.94 \text{ in/HR}$$

$$Q_2 = CAI_2 = (0.9)(0.37)(2.72) = 0.91 \text{ cfs}$$

$$Q_{10} = CAI_{10} = (0.9)(0.37)(4.21) = 1.40 \text{ cfs}$$

$$Q_{100} = CAI_{100} = (0.9)(0.37)(5.94) = 1.98 \text{ cfs}$$

BASIN B3

$$\text{AREA} = 23,878 \text{ SF} = 0.55 \text{ AC}$$

$$\text{IMPERV. SURF.} = 17,167 \text{ SF (71.9\%)}$$

$$\text{PERV. SURFACE} = 6,711 \text{ SF (28.1\%)}$$

$$C' = 0.9(0.719) + 0.35(0.281) = 0.75$$

$$L = 465'$$

$$S = 3.0\%$$

$$T_c = T_i + T_f$$

$$T_i = 4.9 \text{ MIN., } L_m = 90' \text{ (TABLE 3-2)}$$

$$T_f \rightarrow \text{ASSUME } V_{10} = 3.5 \text{ FPS}$$

$$T_f = \frac{465 - 90}{3.5 \times 60} = 1.79 \text{ MIN.}$$

$$T_c = 4.9 + 1.79 = 6.69 \text{ MIN.}$$

$$I_{10} = 2.44(1.7)6.69^{-0.645} = 3.71 \text{ in/HR}$$

$$Q_{10} = CAI_{10} = (0.75)(0.55)(3.71) = 1.53 \text{ CFS}$$

$$\text{FROM FIG. 3-6} \rightarrow V_{10} = 3.5 \text{ FPS} \checkmark$$

$$T_c = 6.69 \text{ MIN.}$$

$$I_2 = 2.44(1.1)6.69^{-0.645} = 2.40 \text{ in/HR}$$

$$I_{10} = 2.44(1.7)6.69^{-0.645} = 3.71 \text{ in/HR}$$

$$I_{100} = 2.44(2.4)6.69^{-0.645} = 5.24 \text{ in/HR}$$

$$Q_2 = CAI_2 = (0.75)(0.55)(2.40) = 0.99 \text{ CFS}$$

$$Q_{10} = CAI_{10} = (0.75)(0.55)(3.71) = 1.53 \text{ CFS}$$

$$Q_{100} = CAI_{100} = (0.75)(0.55)(5.24) = 2.16 \text{ CFS}$$

BASIN C1

$$\text{AREA} = 5,880 \text{ SF} = 0.13 \text{ AC}$$

$$c = 0.35 \text{ (NO IMPERV. SURF.)}$$

$$L = 85'$$

$$S = 0.05\%$$

$$T_c = T_r + T_f$$

$$T_r = 13.2 \text{ min., } L_m = 50' \text{ (TABLE 3-2)}$$

$$T_f = \frac{1.8(1.1-c)JD}{2\sqrt{S}} \quad D = 85 - 50 = 35'$$

$$T_f = \frac{1.8(1.1-0.35)\sqrt{35}}{2\sqrt{0.05}} = 21.7 \text{ min.}$$

USE $T_c = T_r$ FOR CONSERVANCY

$$T_c = 13.2 \text{ min.}$$

$$I_2 = 7.44(1.1)/13.2^{-0.645} = 1.55 \text{ in/hr}$$

$$I_{10} = 7.44(1.7)/13.2^{-0.645} = 2.39 \text{ in/hr}$$

$$I_{100} = 7.44(2.4)/13.2^{-0.645} = 3.38 \text{ in/hr}$$

$$Q_2 = CAI_2 = (0.35)(0.13)(1.55) = 0.07 \text{ cfs}$$

$$Q_{10} = CAI_{10} = (0.35)(0.13)(2.39) = 0.11 \text{ cfs}$$

$$Q_{100} = CAI_{100} = (0.35)(0.13)(3.38) = 0.15 \text{ cfs}$$

BASIN OFF-1

$$\underline{\text{AREA}} = 8,652 \text{ sf} = \underline{0.20 \times C}$$

$$\underline{C} = 0.90 \text{ (ALL IMPERVIOUS)}$$

$$\underline{L} = 360'$$

$$\underline{S} = 3.5/350 = 1.0\%$$

$$T_c = T_i + T_f$$

$$T_i = 4.7 \text{ min.}, L_m = 65' \text{ (TABLE 3-2)}$$

$$T_f \rightarrow \text{Assume } V_{i0} = 2.0 \text{ FPS}$$

$$T_f = \frac{360 - 65}{2.0 \times 60} = 2.46 \text{ min.}$$

$$T_c = 4.7 + 2.46 = 7.16 \text{ min.}$$

$$I_{i0} = 7.44(1.7)7.16^{-0.645} = 3.55 \text{ in/hr}$$

$$Q_{i0} = CA I_{i0} = (0.90)(0.20)(3.55) = 0.64 \text{ cfs}$$

FROM FIG. 3-6 $\rightarrow V_{i0} = 2.0 \text{ FPS} \checkmark$

$$\underline{T_c = 6.11 \text{ min.}}$$

$$I_2 = 7.44(1.1)7.16^{-0.645} = 2.30 \text{ in/hr}$$

$$I_{i0} = 7.44(1.7)7.16^{-0.645} = 3.55 \text{ in/hr}$$

$$I_{i0s} = 7.44(2.4)7.16^{-0.645} = 5.02 \text{ in/hr}$$

$$Q_2 = CA I_2 = (0.90)(0.20)(2.30) = 0.41 \text{ cfs}$$

$$Q_{i0} = CA I_{i0} = (0.90)(0.20)(3.55) = 0.64 \text{ cfs}$$

$$Q_{i0s} = CA I_{i0s} = (0.90)(0.20)(5.02) = 0.90 \text{ cfs}$$

BASIN OFF-2

$$\underline{\text{AREA}} = 3,333 \text{ SF} = \underline{0.08 \text{ AC}}$$

$$\underline{C} = \underline{0.90} \text{ (ALL IMPERVIOUS)}$$

$$\underline{L} = \underline{125'}$$

$$\underline{S} = 3/125 = \underline{2.4\%}$$

$$T_c = T_i + T_f$$

$$\underline{T_i} = 3.9 \text{ min.}, L_m = 80' \text{ (TABLE 3-2)}$$

$$T_f \rightarrow \text{Assume } V_{10} = 3.0 \text{ FPS}$$

$$T_f = \frac{125 - 80}{30 \times 60} = 0.25 \text{ min.}$$

$$T_c = 3.9 + 0.25 = 4.15 \rightarrow \underline{\text{USE } 5.0 \text{ min. (MINIMUM)}}$$

$$I_{10} = 7.44(1.7)5.0^{-0.645} = 4.48 \text{ in/hr}$$

$$Q_{10} = CAI_{10} = (0.9)(0.08)(4.48) = 0.32 \text{ cfs}$$

FROM FIG. 3-6 $\rightarrow V_{10} = 3.0 \text{ FPS} \checkmark$

$$T_c = 5.00 \text{ min.}$$

$$I_2 = 7.44(1.1)5.0^{-0.645} = \underline{2.90 \text{ in/hr}}$$

$$I_{10} = 7.44(1.7)5.0^{-0.645} = \underline{4.48 \text{ in/hr}}$$

$$I_{100} = 7.44(2.4)5.0^{-0.645} = \underline{6.32 \text{ in/hr}}$$

$$Q_2 = CAI_2 = (0.9)(0.08)(2.90) = \underline{0.21 \text{ cfs}}$$

$$Q_{10} = CAI_{10} = (0.9)(0.08)(4.48) = \underline{0.32 \text{ cfs}}$$

$$Q_{100} = CAI_{100} = (0.9)(0.08)(6.32) = \underline{0.46 \text{ cfs}}$$

APPENDIX 2

HYDRAULIC CALCULATIONS

HYDRAULIC CALCS

BASIN EX-B

$$Q_{100} = 1.80 \text{ cfs}$$

+ SIZE OPENING IN WALL

TRY 16" X 8" OPENING

$$\begin{aligned} Q_{MAX} &= CA\sqrt{2gh} \\ &= (6)(.89)\sqrt{2(32.2)(2.25)} \end{aligned}$$

$$Q_{MAX} = 2.40 \text{ cfs}$$

$$2.40 > 1.80$$

$$\begin{aligned} C &= 0.67 \text{ (Kings Handbook)} \\ A &= 1.33 \times .67 = 0.895 \text{ ft}^2 \\ h &= \frac{3}{3} \end{aligned}$$

∴ USE 16" X 8" OPENING IN WALL

+ SIZE BROW DITCH

$$Q_{MAX} = \frac{1.486 AR^{2/3} S^{1/2}}{n}$$

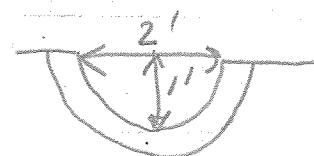
$$= \frac{1.486 (1.57)(.5)^{2/3} \sqrt{.01}}{.015}$$

$$n = 0.015$$

$$\begin{aligned} A &= 1.57 \\ h &= 0.50 \\ S &= 1/0.00 = 100 \text{ min.} \end{aligned}$$

$$Q_{MAX} = 9.8 \text{ cfs}$$

$$9.8 > 1.80$$



∴ USE 2' X 1' PCC TYPE 'B' BROW DITCH
C 1.0% MIN. SLOPE

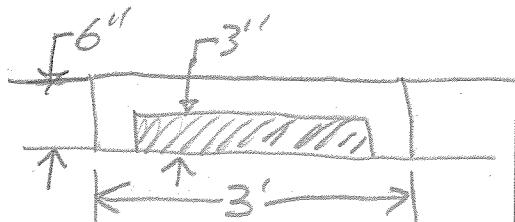
+ SIZE CURB OUTLET

(TRANSITION CURB HEIGHT FROM 4-6 INCHES)

$$Q_{MAX} = C A \sqrt{2gh}$$
$$= (0.65)(.75) \sqrt{2(32.2)(.5)}$$

$$Q_{MAX} = 2.76 \text{ cfs}$$

$$2.76 > 1.80$$



$$C = 0.65 (\text{Kings})$$

$$A = 3 \times .25 = 0.75 \text{ ft}^2$$

$$h = 0.5'$$

∴ USE TYPE 'A' CURB
OUTLET w/ 3' OPENING

BASIN EX-C

$$Q_{100} = 0.6 \text{ cfs}$$

+ SIZE OPENING IN WALL

TRY 16" X 8" OPENING

$$Q_{MAX} = 2.4 \text{ cfs (PER SHEET)}$$

$$2.4 > 0.61$$

∴ USE 16" X 8" OPENING IN WALL

(PROVIDE 2 OPENINGS BASED ON
WHERE FLOW MAY MEET WALL)

+ SIZE BROW DITCH

TRY 2' X 1' PCC DITCH @ 1.0% MIN. SLOPE

$$Q_{MAX} = 9.8 \text{ cfs (SEE SHEET 1)}$$

$$9.8 > 0.61$$

∴ USE 2' X 1' PCC TYPE 'B' BROW DITCH

@ 1.0% MIN. SLOPE

+ SIZE CURB OUTLET

TRY TYPE A CURB OUTLET

$$Q_{MAX} = 2.76 \text{ cfs (SEE SHT. 2)}$$

$$2.76 > 0.61$$

∴ USE TYPE A CURB OUTLET w/ 3' OPENING

(IF NECESSARY)

BASIN A1

$$Q_{100} = 2.95 \text{ cfs}$$

+ CHECK DEPTH OF FLOW IN GUTTER

$$\begin{aligned} S = 1.0\% &\rightarrow d = 0.32' \text{, (FIG. 3-6)} \\ S = 2.0\% &\rightarrow d = 0.24' \end{aligned}$$

$$\text{CURB HEIGHT} = 0.33' (4")$$

$$0.33 > 0.32 \rightarrow \checkmark$$

+ SIZE CURB INLET (ON-GRADE)

$$L = \frac{Q_{100}}{0.7(a+y)^{3/2}}$$

$$\begin{aligned} a &= 0.33 \\ y &= 0.24 \text{ (7th STREET)} \end{aligned}$$

$$= \frac{2.95}{0.7(0.33+0.24)^{3/2}} = 9.8' \approx 10' \text{ OPENING}$$

∴ USE 11' TYPE B-1' CURB INLET

+ SIZE PIPE

TRY 12" PVC @ 1.0% MIN. SLOPE

$$Q_{MAX} = 35.6 \sqrt{0.1} = 3.56 \text{ cfs}$$

$$3.56 > 2.95$$

∴ USE 12" PVC @ 1.0% MIN. SLOPE

BASIN A2

$$Q_{100} = 3.33 \text{ cfs}$$

+ CHECK DEPTH OF FLOW IN GUTTER

$$\begin{aligned} S = 1.0\% &\rightarrow d = 0.33' \quad (\text{FIG. 3-6}) \\ S = 5.0\% &\rightarrow d = 0.27' \end{aligned}$$

$$\text{CURB HEIGHT} = 0.33' (4")$$

$$0.33 = 0.33 \rightarrow \checkmark$$

+ SIZE CURB INLET (ON-GRADE)

$$L = \frac{Q_{100}}{n(a+y)^{3/2}}$$

$$\begin{aligned} a &= 0.33 \\ y &= 0.27 \quad (\text{5\% 57' EET}) \end{aligned}$$

$$= \frac{3.33}{1.7(0.33+0.27)^{3/2}} = 10.2 \approx 11' \text{ SPACING}$$

∴ USE 12' TYPE B-1' CURB INLET

+ SIZE PIPE

TRY 12" PVC @ 1.0% MIN. SLOPE

$$Q_{MAX} = 35.6 \sqrt{0.1} = 3.56 \text{ cfs}$$

$$3.56 > 3.33$$

∴ USE 12" PVC @ 1.0% MIN. SLOPE

BASIN A3

$$Q_{100} = A_3 + EX - B + EX - C \quad (\text{ROUTE FLOWS})$$

$$= 3.21 + \frac{5.18}{7.19}(1.80) + \frac{5.18}{5.22}(0.61)$$

$$Q_{100} = 5.12 \text{ cfs}$$

+ CHECK DEPTH OF FLOW IN GUTTER

$$S_2 = 4.0\% \rightarrow d = 0.31' \quad (\text{FIG. 3-6})$$

$$S_2 = 5.0\% \rightarrow d = 0.30'$$

CURB HEIGHT = 0.33' (4")

$$0.33' > 0.31' \rightarrow \checkmark$$

+ SIZE CURB INLET (ON-GRADE)

$$L = \frac{Q_{100}}{0.2(q+y)^{3/2}}$$

$$q = 0.33$$

$$y = 0.29 \quad (5\% \text{ SLOPE})$$

$$= \frac{5.12}{0.2(0.33+0.29)^{3/2}} = 14.3 \approx 15' \text{ OPENING}$$

\therefore USE 16' TYPE B-1' CURB INLET

+ SIZE PIPE - RULV #1

TRY 18" RCP @ 1.0% MIN. SLOPE

$$Q_{MAX} = 105\sqrt{0.1} = 10.5 \text{ cfs}$$

$$10.5 > 5.12$$

\therefore USE 18" RCP @ 1.0% MIN. SLOPE

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+ SIZE PIPE - Run #2

$$Q_{100} = A_1 + A_2 + A_3 + E_1 - B + E_2 - C$$
$$= 2.95 + 3.33 \left(\frac{7.20}{9.54} \right) + 5.12 \left(\frac{6.82}{9.54} \right) = 9.12 \text{ cfs}$$

TRY 18" RCP @ 1.0% MIN. SLOPE

$$Q_{MAX} = 105 \sqrt{0.01} = 10.5 \text{ cfs}$$

$$10.5 > 9.12$$

∴ USE 18" RCP @ 1.0% MIN. SLOPE

BASIN A4

$$Q_{100} = 3.70 \text{ cfs}$$

+ CHECK GUTTER FLOW DEPTH

$$S = 1.0\% \rightarrow d = 0.34' \text{ (FIG. 3-6)}$$

CURB HEIGHT AT INLET = 6" (0.5')

$$0.5 > 0.34 \checkmark$$

+ SIZE CURB INLET (sump)

$$L = \frac{Q_{100}}{C_w d^{3/2}}$$

$$C_w = 3.0$$

$$d = 0.5'$$

$$L = \frac{3.70}{3.0 (0.5)^{3/2}} = 3.5 \approx 4' \text{ OPENING}$$

\therefore USE 5' TYPE 'B' CURB INLET

+ SIZE PIPE - RUN #1

TRY 12" PVC @ 2.0% MIN. SLOPE

$$Q_{max} = 35.6 \sqrt{0.02} = 5.03 \text{ cfs}$$

$$5.03 > 3.70$$

\therefore USE 12" PVC @ 2.0% MIN. SLOPE

+ SIZE PIPE - RUN #2

$$\underline{Q_{100}} = A_1 + A_2 + A_3 + A_4 + E_1 + E_2$$
$$= 9.12 + 3.70 \left(\frac{4.10}{4.43} \right) = \underline{12.60 \text{ cfs}}$$

TRY 24" RCP @ 0.50% MIN. SLOPE

$$Q_{MAX} = 226 \sqrt{.005} = 15.98 \text{ cfs}$$

$$15.98 > 12.60$$

\therefore USE 24" RCP @ 0.50% MIN. SLOPE

BASIN AS

$$Q_{100} = 2.44 \text{ cfs}$$

+ CHECK GUTTER FLOW DEPTH

$$S = 1.0\% \rightarrow d = 0.30' (\text{FIG. 3-6})$$

CURB HEIGHT AT INLET = 0.5' (6")

$$0.5 > 0.3 \rightarrow \checkmark$$

+ SIZE CURB INLET (SUMP)

$$L = \frac{Q_{100}}{C_w d^{3/2}} \quad C_w = 3.0$$

$$d = 0.5'$$

$$= \frac{2.44}{3.0(0.5)^{3/2}} = 2.3' \approx 3.0' \text{ OPENING}$$

∴ USE 5' TYPE 'B' CURB INLET

+ SIZE PIPE

$$Q_{100} = 12.60 + 2.44 \left(\frac{4.17}{4.32} \right) = \underline{\underline{14.95 \text{ cfs}}}$$

TRY 24" RCP @ 0.50% MIN. SLOPE

$$Q_{max} = 226 \sqrt{0.05} = 15.98 \text{ cfs}$$

$$15.98 > 14.95$$

∴ USE 24" RCP @ 0.50% MIN. SLOPE

BASIN B1

$$Q_{\text{des}} = BI + OFF-H = 2.20 + 0.90 \left(\frac{400}{502} \right) = 2.93$$

+ CHECK GUTTER FLOW DEPTH

$$S = 4.0\% \rightarrow d = 0.26' \text{ (FIG. 3-6)}$$

CURB HEIGHT = 0.5' (6")

$$0.50 > 0.26 \rightarrow \checkmark$$

+ SIZE CURB INLET (ON-GRADE)

$$L = \frac{Q_{\text{des}}}{0.7(q+y)32} \quad q = 0.33 \\ y = 0.26$$

$$L = \frac{2.93}{0.7(0.33+0.26)32} = 9.3' \approx 10' \text{ OPENING}$$

\therefore USE 11' TYPE 'B' CURB INLET

+ SIZE PIPE

TRY 18" RCP c 1.0% MIN. SLOPE

$$Q_{\text{MAX}} = 105 \sqrt{0.1} = 10.5 \text{ CFS}$$

$$10.5 > 2.93$$

\therefore USE 18" RCP c 1.0% MIN. SLOPE

BASIN B2

$$Q_{100} = 1.98 \text{ cfs}$$

+ CHECK GUTTER FLOW DEPTH

$$S = 3.3\% \rightarrow d = 0.24' \text{ (FIG. 3-6)}$$

$$\text{CURB HEIGHT} = 0.5'(6")$$

$$0.5 > 0.24 \rightarrow \checkmark$$

+ SIZE CURB INLET (ON-GRADE)

$$L = \frac{Q_{100}}{0.7(\alpha\gamma)^{3/2}}$$

$$\begin{aligned} \alpha &= 0.33 \\ \gamma &= 0.24 \end{aligned}$$

$$L = \frac{1.98}{0.7(0.33+0.24)^{3/2}} = 6.6' \times 7' \text{ OPENING}$$

\therefore USE 8' TYPE B-1 'CURB INLET'

+ SIZE PIPE - RUN #1

TRY 18" RCP @ 1.0% MIN. SLOPE

$$Q_{MAX} = 105 \cdot .01 = 10.5 \text{ cfs}$$

$$10.5 > 1.98$$

\therefore USE 18" RCP @ 1.0% MIN. SLOPE

+ SIZE PIPE - RUN #2

$$Q_{100} = B_1 + B_2 + E_2 - A$$

$$\underline{Q_{100}} = 2.93 + 1.98(4.08/5.94) = \underline{4.29 \text{ cfs}}$$

TRY 18" RCPC 1.0% MIN. SLOPE

$$Q_{MAX} = 105 \text{ SFT} = 10.5 \text{ cfs}$$

$$10.5 > 4.29$$

∴ USE 18" RCPC 1.0% MIN. SLOPE

BASIN B3

$$Q_{100} = 2.16 \text{ cfs}$$

+ CHECK GUTTER FLOW DEPTH

$$S = 3.3\% \rightarrow d = 0.24' \text{ (FIG. 3-6)}$$

CURB HEIGHT = 0.5" (6")

$$0.50 > 0.24 \rightarrow \checkmark$$

+ SIZE CURB INLET (ON-GRADE)

$$L = \frac{Q_{100}}{\pi(a+y)^{3/2}} \quad a = 0.33 \\ y = 0.24$$

$$L = \frac{2.16}{\pi(0.33+0.24)^{3/2}} = 7.2 \approx 8' \text{ OPENING}$$

∴ USE 9' TYPE 'B-1' CURB INLET

+ SIZE PIPE

$$Q_{100} = B1 + B2 + B3 + \text{EX-A}$$

$$Q_{100} = 4.29 + 2.16 (4.08/5.24) = \underline{5.97 \text{ cfs}}$$

TR4 18" RCP @ 1.0% MIN. SLOPE

$$Q_{MAX} = 105 \sqrt{.01} = 10.5 \text{ cfs}$$

$$10.5 > 5.97$$

∴ USE 18" RCP @ 1.0% MIN. SLOPE

BASIN OFF-1

$$Q_{100} = 0.90 \text{ cfs}$$

+ CHECK GUTTER DEPTH FLOOR

$$S = 1.0\% \rightarrow d = 0.24' \quad (\text{F16. 3-6})$$

CURB HEIGHT = 6" (0.5')

$$0.50 > 0.24 \checkmark$$

BASIN OFF-2

$$Q_{100} = 0.46 \text{ cfs}$$

+ CHECK GUTTER FLOW DEPTH

$$S = 2.4\% \rightarrow d = 0.21' \text{ (FIG. 3-6)}$$

$$\text{CURB HEIGHT} = 0.5' (6")$$

$$0.50 > 0.21 \quad \checkmark$$

+ SIZE CURB INLET (ON-GRADE)

$$L = \frac{Q_{100}}{\pi(a+y)^{3/2}}$$

$$a = 0.33 \\ y = 0.21$$

$$L = \frac{0.46}{\pi(0.33+0.21)^{3/2}} = 1.7' \approx 2' \text{ OPENING}$$

∴ USE 5' 7" DE 'B' CURB INLET

+ SIZE PIPE

TRY 18" RCP @ 1.0% MIN. SLOPE

$$Q_{MAX} = 105 \text{ ft/s} = 10.5 \text{ cfs}$$

$$10.5 > 0.46$$

∴ USE 18" RCP @ 1.0% MIN. SLOPE

BASIN C1

ROUTE ALL FLOWS IN BASIN

LARGEST T_c = BASIN C1 (13.20 min.)
USE RATIOS OF T_{c5} TO ROUTE FLOWS

<u>BASIN Q₁₀₀</u>	<u>T_c</u>	<u>$T_c/T_c C1$</u>	<u>ROUTED Q₁₀₀</u>
A1	2.95	9.54	9.54/13.2
A2	3.33	7.20	7.20/13.2
A3	3.21	6.82	6.82/13.2
A4	3.70	8.67	8.67/13.2
A5	2.44	9.03	9.03/13.2
B1	2.20	7.85	7.85/13.2
B2	1.98	5.51	5.51/13.2
B3	2.16	6.69	6.69/13.2
OFF-1	0.90	7.16	7.16/13.2
EX-B	1.80	4.10	4.10/13.2
EX-C	0.61	6.74	6.74/13.2
			<u>0.31</u>

$$\begin{aligned} \text{TOTAL ROUTED } Q_{100} &= \frac{14.62 \text{ cfs}}{+0.15} \\ &+ C1 = \frac{-}{14.82 \text{ cfs}} \end{aligned}$$

+ SIZE GRATED INLET

TRY TYPE G' INLET

$$\begin{aligned} Q_{MAX} &= CA\sqrt{2gh} \\ &= (.6)(6.6)\sqrt{2(32.2)(25)} \end{aligned}$$

$$\begin{aligned} C &= 0.67 (\text{Kings}) \\ A &= 2 \times 3.3 = 6.6 \text{ sf} \\ h &= 0.25' \end{aligned}$$

$$Q_{MAX} = 17.7 \text{ cfs} > 14.82$$

$\therefore \text{USE TYPE G' INLET}$

+ SIZE PIPE

TRY 24" RCP @ 1.0% MIN. SLOPE

$$Q_{MAX} = 226\sqrt{.01} = 22.6 \text{ cfs}$$

$$22.6 > 14.82$$

: USE 24" RCP @ 1.0% MIN. SLOPE

+ CHECK CAPACITY OF 36" RCP IN MARROKAL

MIN. SLOPE = 3.0%

$$Q_{100} = 95.3 * + 14.82 = 110.12 \text{ cfs}$$

* TAKEN FROM DRAINAGE CALC'S FOR
MARROKAL STORM DRAIN DATED 1-5-02
(SEE NEXT SHEET)

$$Q_{MAX} = 666\sqrt{.03} = 115.4 \text{ cfs}$$

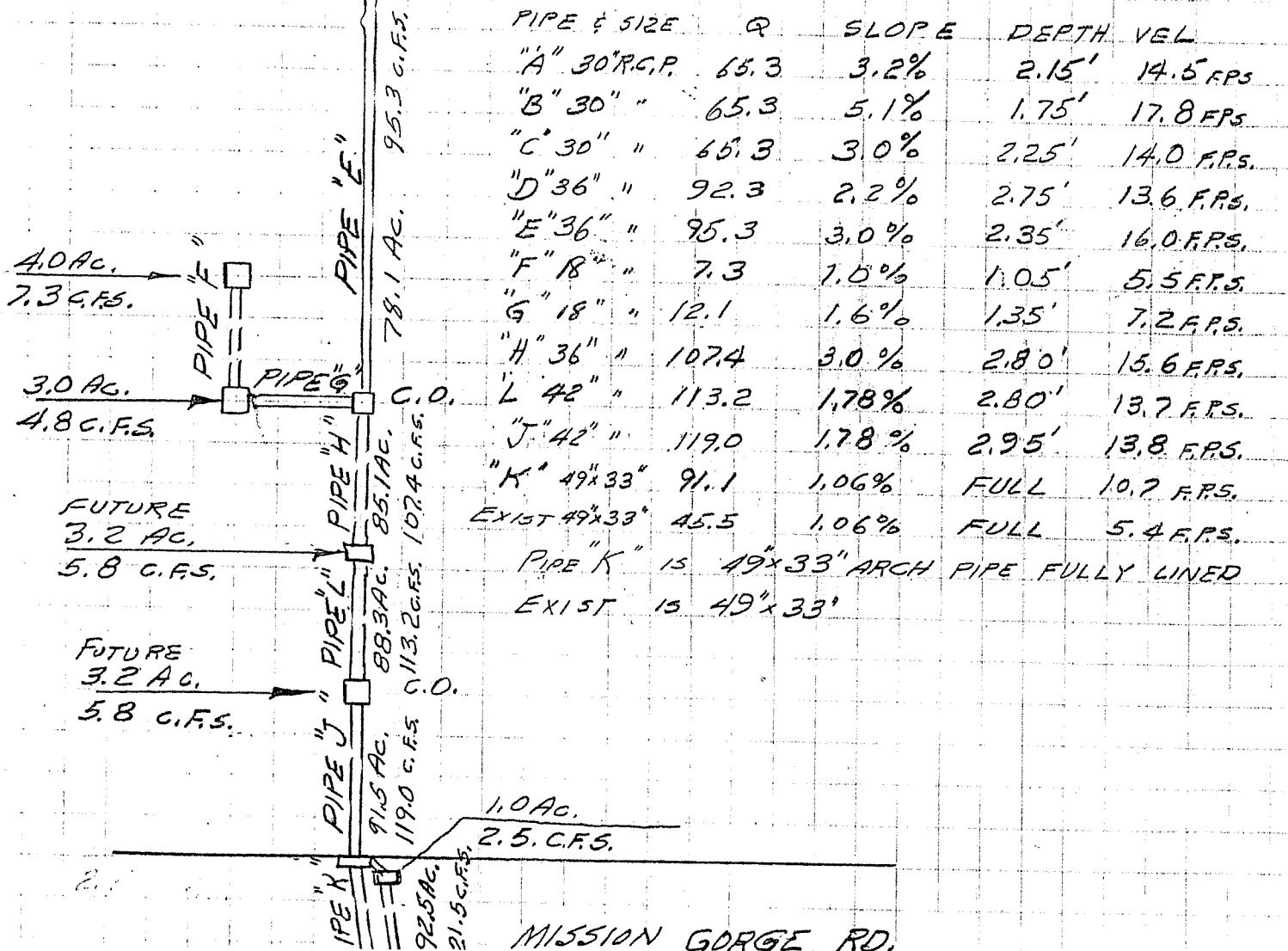
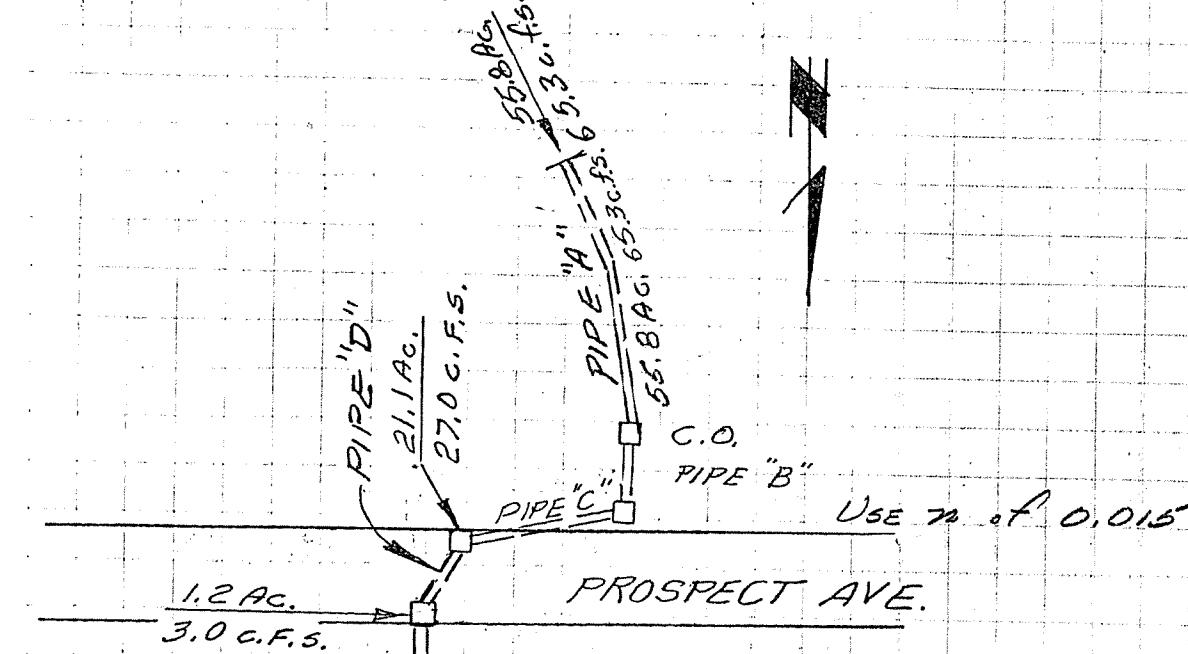
$$115.4 > 110.12 \text{ cfs}$$

: EXISTING 36" RCP IN MARROKAL IS ADEQUATE

DRAINAGE CALCULATION
SOUTH & NORTH PROSPECT
W. O. # 1643

1-5-82
W.O. No. 1643
SHEET 2 OF 4

5. Drainage Layout



1-5-82

W.O. NO. 1643

SHEET 1 OF 4

DRAINAGE CALCULATION
SOUTH & NORTH Prospect
N.O. # 1643 & 1655

1. Time of concentration = 17.5 MINUTES
 Rainfall $I_{100} = 2.6 \text{ c.f.s. /hr.}$

2. Runoff coefficients
 Solid Type = D

Multi-Units = 0.70 Rural = 0.45

3. Runoff calc.

$$3.2 \text{ Ac.} \times 0.70 \times 2.6 = 5.8 \text{ c.f.s.}$$

$$17.6 \text{ Ac.} \times 0.45 \times 2.6 = 20.6 \text{ c.f.s.}$$

$$55.8 \text{ Ac.} \times 0.45 \times 2.6 = 65.3 \text{ c.f.s.}$$

$$3.5 \text{ Ac.} \times 0.70 \times 2.6 = 6.4 \text{ c.f.s.}$$

$$(\text{street}) 1.2 \text{ Ac.} \times 0.95 \times 2.6 = 3.0 \text{ c.f.s.}$$

$$3.0 \text{ Ac.} \times 0.70 \times 2.6 = 4.8 \text{ c.f.s.}$$

$$4.0 \text{ Ac.} \times 0.70 \times 2.6 = 7.3 \text{ c.f.s.}$$

4. SIZE INLETS: ALL INLETS ARE SUMP.

INLET SOUTH SIDE PROSPECT will receive 27 c.f.s.
 will construct 20 type B-2 and let overage
 go to 20' type B-2 constructed on north side of
 Prospect, total for two inlets will be 30 c.f.s.

INLETS IN North Prospect Inc. will receive 7.3
 or 48 c.f.s. $7.3 \times 2 = 14.6$ (Use 20' TYPE "B-2")
 $4.8 \times 2 = 9.6$ (Use 15' TYPE "B-2")

APPENDIX 3

CITY OF SANTEE / COUNTY OF SAN DIEGO DRAINAGE DESIGN MANUAL CHARTS/FIGURES

County of San Diego Hydrology Manual



Rainfall Isopluvials

2 Year Rainfall Event - 6 Hours

..... Isopluvial (inches)



We Have San Diego. Given a try.



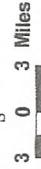
Department of Public Works
Division of Water Resources

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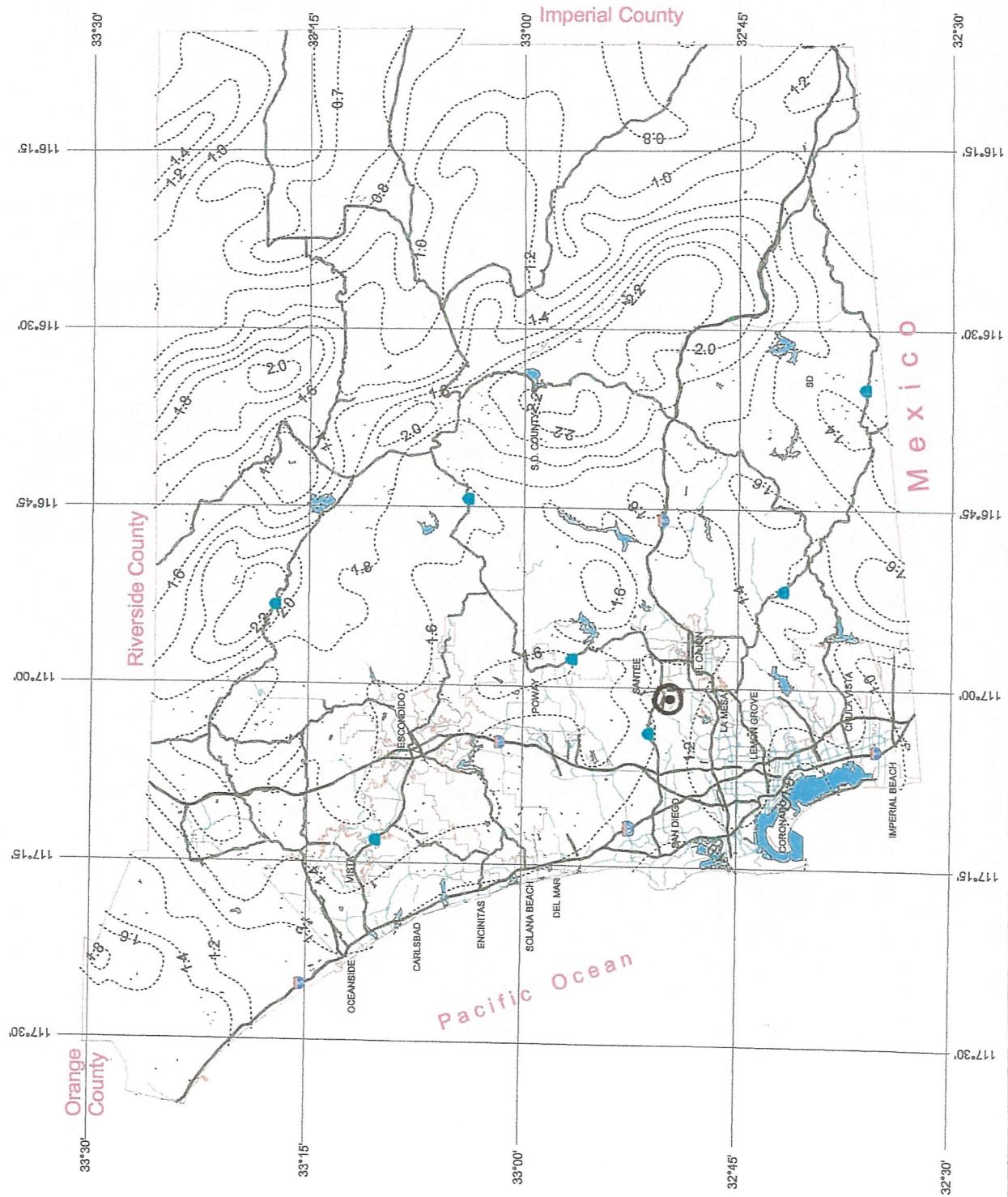
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N S
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3 0 3 Miles



County of San Diego Hydrology Manual



Rainfall Isopluvials

2 Year Rainfall Event - 24 Hours

..... Isopluvial (inches)



We Have San Diego Covered!

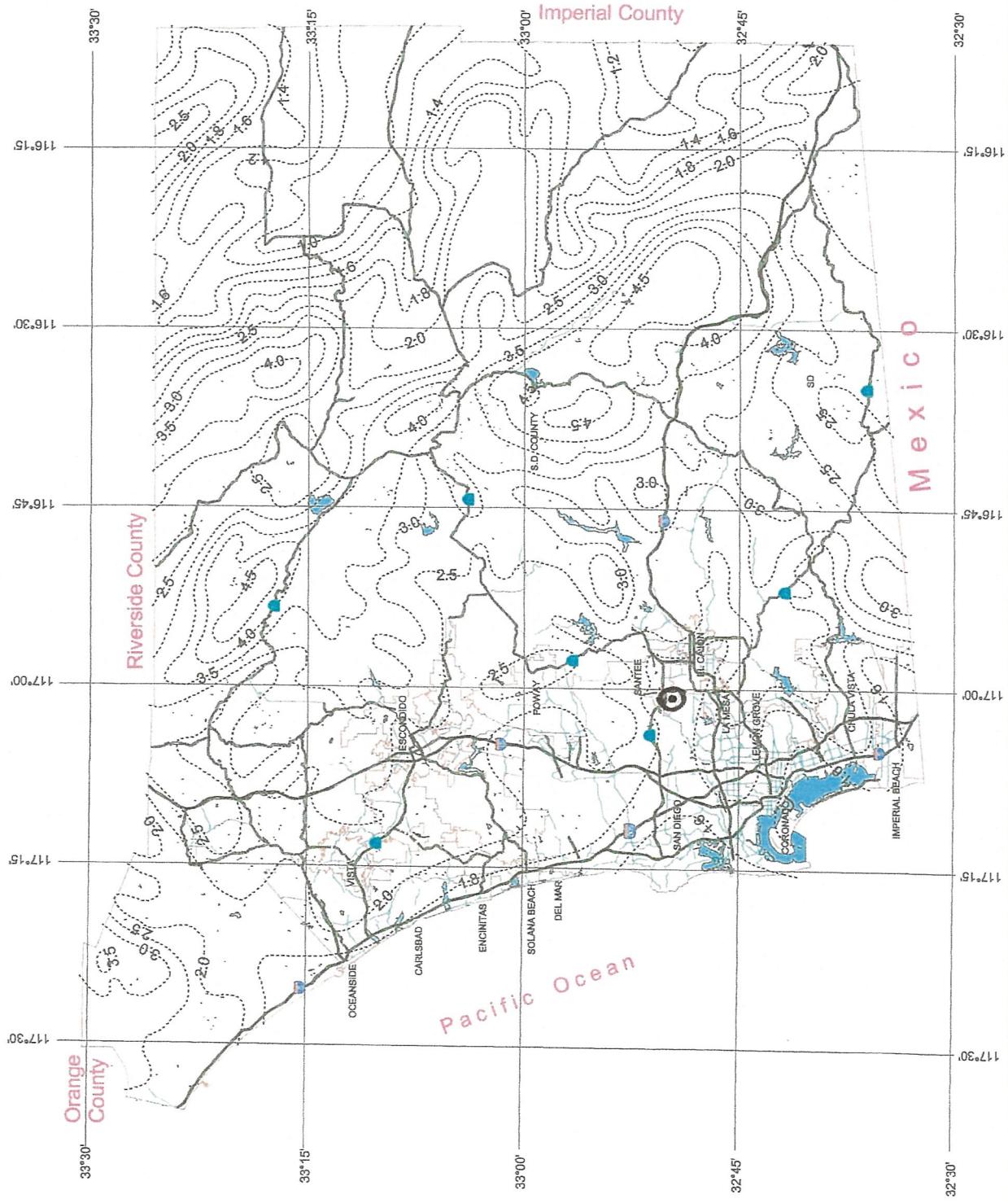
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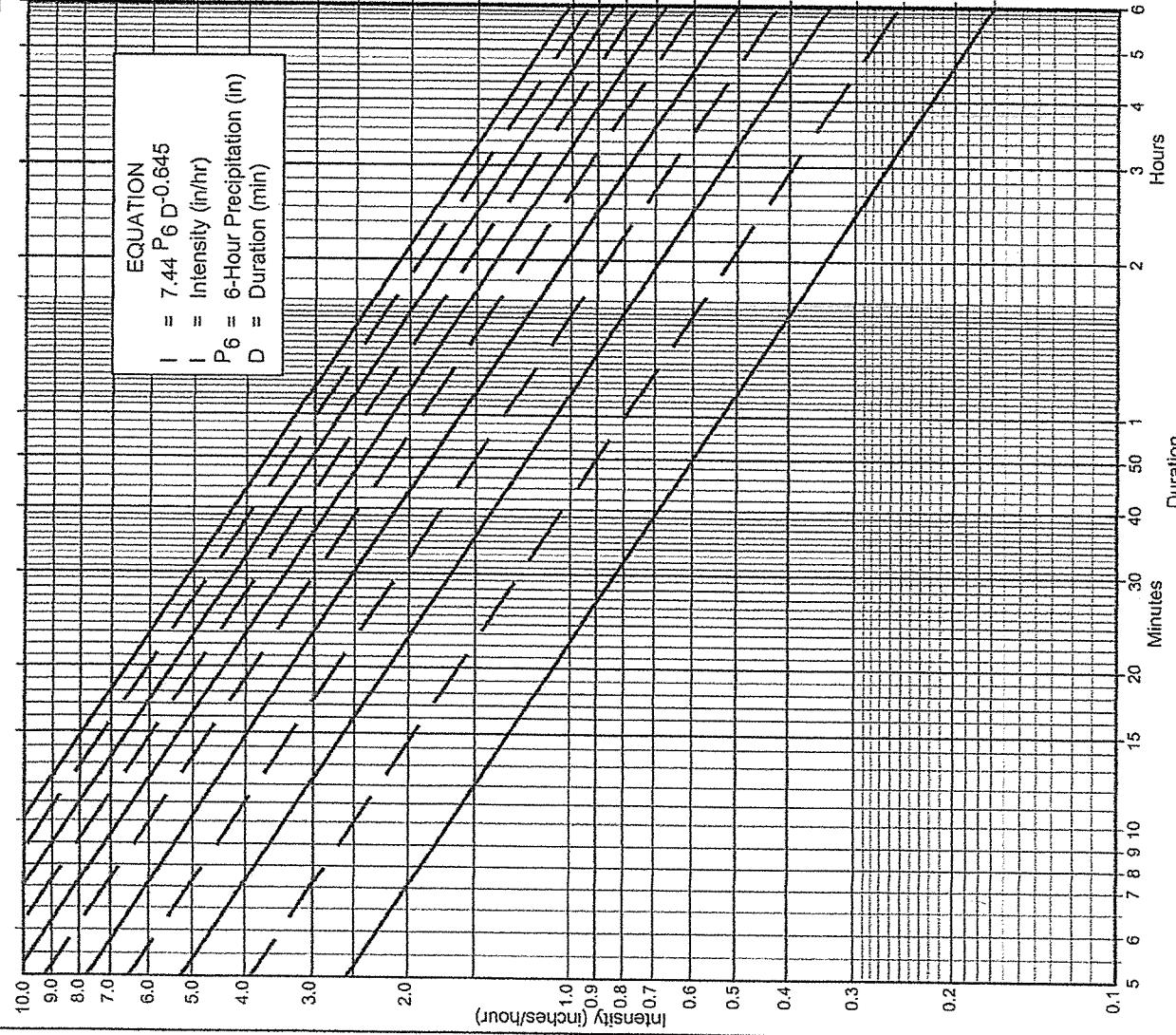
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3 Miles





Directions for Application:

- (1) From precipitation maps determine 6 hr and 24 hr amounts for the selected frequency. These maps are included in the County Hydrology Manual (10, 50, and 100 yr maps included in the Design and Procedure Manual).
- (2) Adjust 6 hr precipitation (if necessary) so that it is within the range of 45% to 65% of the 24 hr precipitation (not applicable to Desert).
- (3) Plot 6 hr precipitation on the right side of the chart.
- (4) Draw a line through the point parallel to the plotted lines.
- (5) This line is the intensity-duration curve for the location being analyzed.

Application Form:

- (a) Selected frequency 10 year
- (b) $P_6 = \underline{1.7} \text{ in.}$, $P_{24} = \underline{2.9} \frac{P_6}{P_{24}} = \underline{5.9} \% (2)$
- (c) Adjusted $P_6^{(2)} = \underline{1.7} \text{ in.}$
- (d) $t_x = \underline{\quad}$ min.
- (e) $I = \underline{\quad}$ in./hr.

Note: This chart replaces the Intensity-Duration-Frequency curves used since 1965.

P ₆	1	1.5	2	2.5	3	3.5	4	4.5	5	5.5	6
Duration	1	1	1	1	1	1	1	1	1	1	1
5	2.63	3.95	5.27	6.59	7.90	9.22	10.54	11.86	13.17	14.49	15.81
7	2.12	3.18	4.24	5.30	6.36	7.42	8.48	9.54	10.60	11.66	12.72
10	1.68	2.53	3.37	4.21	5.05	5.90	6.74	7.58	8.42	9.27	10.11
15	1.30	1.95	2.59	3.24	3.89	4.54	5.19	5.84	6.49	7.13	7.78
20	1.08	1.62	2.15	2.69	3.23	3.77	4.31	4.85	5.39	5.93	6.46
25	0.93	1.40	1.87	2.33	2.80	3.27	3.73	4.20	4.67	5.13	5.60
30	0.83	1.24	1.66	2.07	2.49	2.90	3.32	3.73	4.15	4.56	4.98
40	0.69	1.03	1.38	1.72	2.07	2.41	2.76	3.10	3.45	3.79	4.13
50	0.60	0.90	1.19	1.49	1.79	2.09	2.39	2.69	2.98	3.28	3.58
60	0.53	0.80	1.06	1.33	1.59	1.86	2.12	2.39	2.65	2.92	3.18
90	0.41	0.61	0.82	1.02	1.23	1.43	1.63	1.84	2.04	2.25	2.45
120	0.34	0.51	0.68	0.85	1.02	1.19	1.36	1.53	1.70	1.87	2.04
150	0.29	0.44	0.59	0.73	0.88	1.03	1.18	1.32	1.47	1.62	1.76
180	0.26	0.39	0.52	0.65	0.78	0.91	1.04	1.18	1.31	1.44	1.57
240	0.22	0.33	0.43	0.54	0.65	0.76	0.87	0.98	1.08	1.19	1.30
300	0.19	0.28	0.38	0.47	0.56	0.66	0.75	0.85	0.94	1.03	1.13
360	0.17	0.25	0.33	0.42	0.50	0.58	0.67	0.75	0.84	0.92	1.00

FIGURE
3-1

Intensity-Duration Design Chart - Template

County of San Diego
Hydrology Manual



Rainfall Isoplevials

10 Year Rainfall Event - 6 Hours

Isopluvial (inches)



County of San Diego Hydrology Manual



Rainfall Isopluvials

10 Year Rainfall Event - 24 Hours

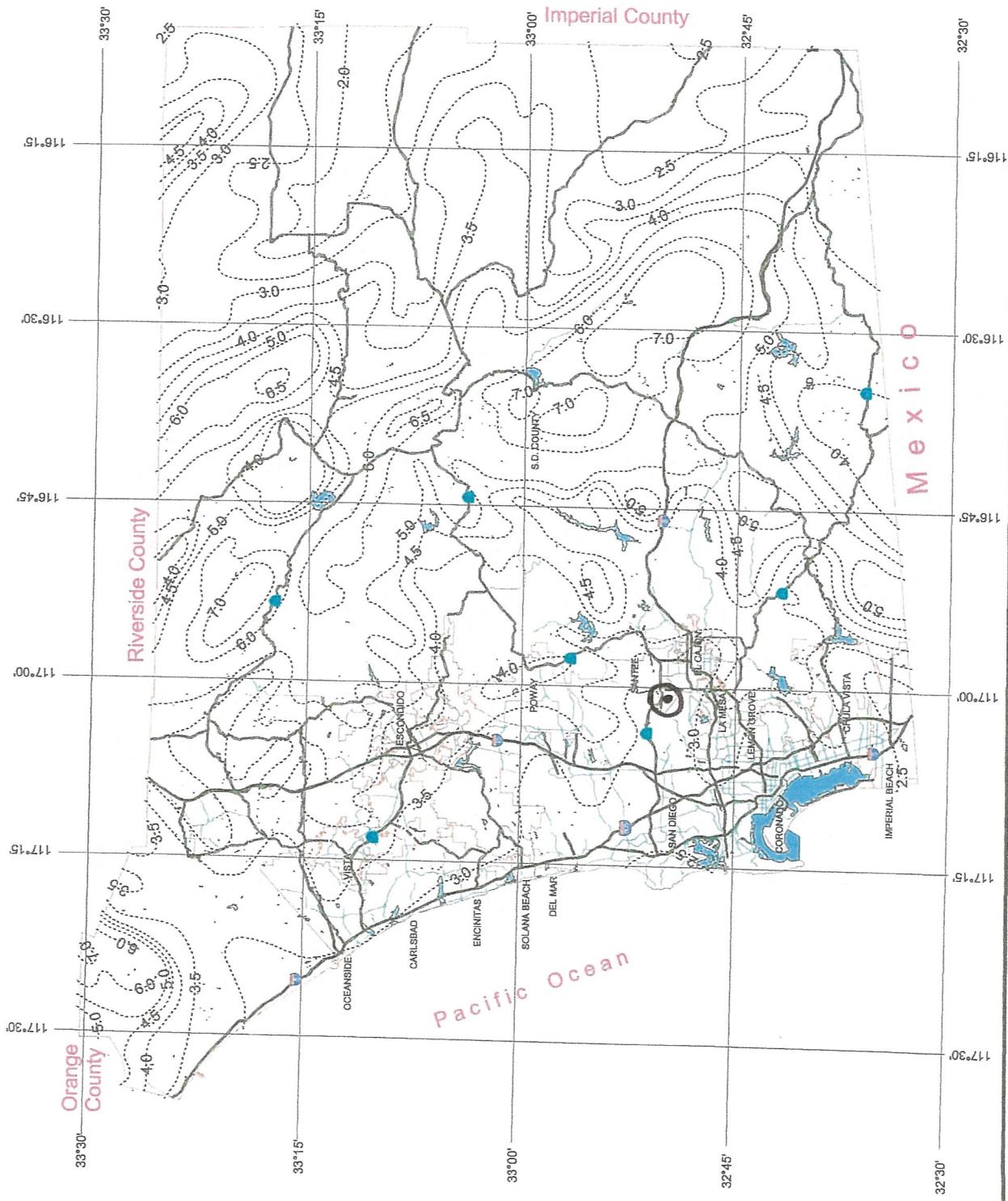
Isopluvial (inches)



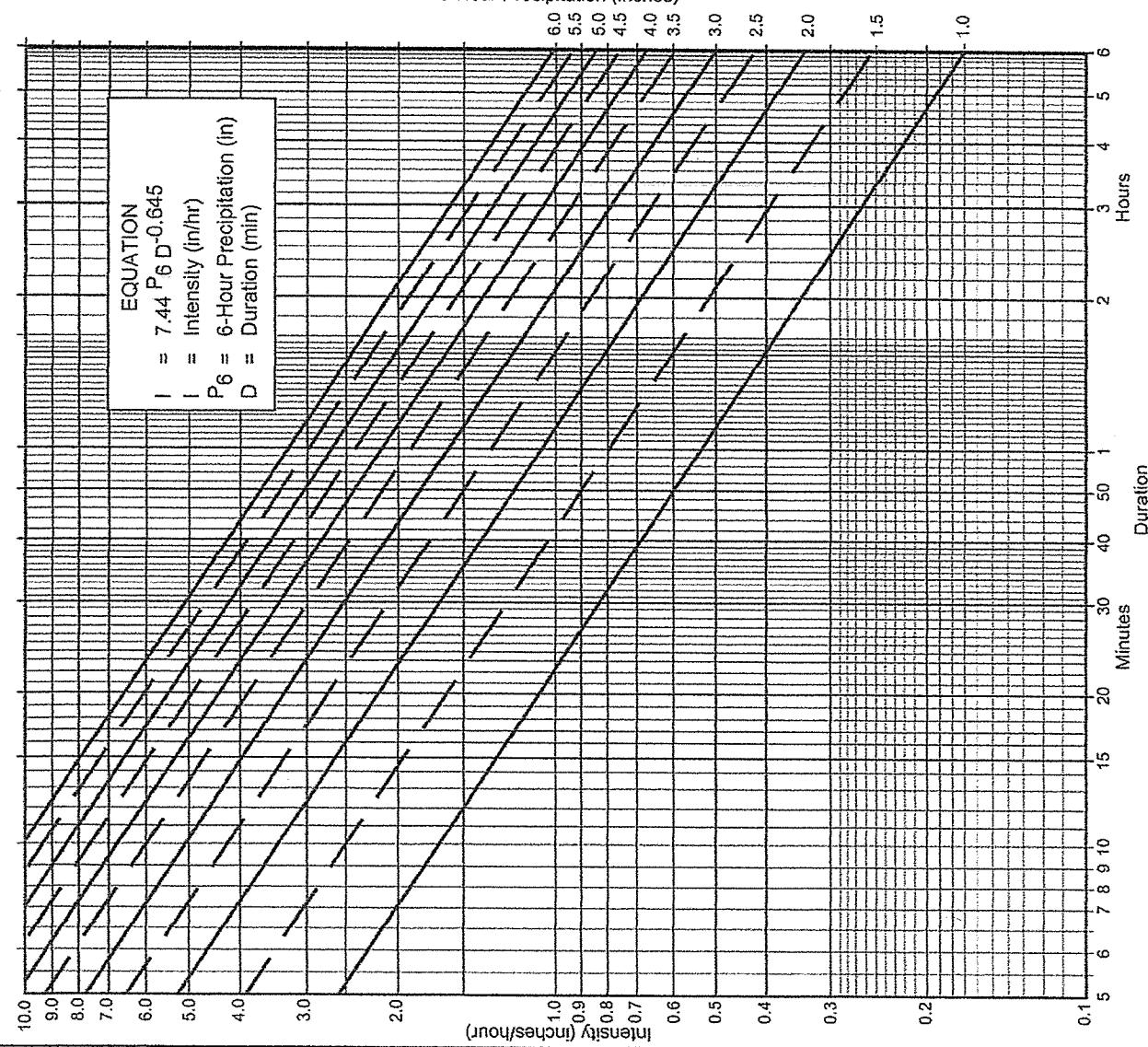
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32°30' 33°00' 33°30'
116°15' 116°30' 116°45' 117°00' 117°15'
N S E W
3 Miles



Intensity-Duration Design Chart - Template



Directions for Application:

- (1) From precipitation maps determine 6 hr and 24 hr amounts for the selected frequency. These maps are included in the County Hydrology Manual (10, 50, and 100 yr maps included in the Design and Procedure Manual).
- (2) Adjust 6 hr precipitation (if necessary) so that it is within the range of 45% to 65% of the 24 hr precipitation (not applicable to Desert).
- (3) Plot 6 hr precipitation on the right side of the chart.
- (4) Draw a line through the point parallel to the plotted lines.
- (5) This line is the intensity-duration curve for the location being analyzed.

Application Form:

- (a) Selected frequency 100 year
- (b) $P_6 = \underline{2.4}$ in., $P_{24} = \underline{4.4}$ in.
- (c) Adjusted $P_6^{(2)} = \underline{2.4}$ in.
- (d) $t_x = \underline{\quad}$ min.
- (e) $I = \underline{\quad}$ in./hr.

Note: This chart replaces the Intensity-Duration-Frequency curves used since 1965.

P ₆	1	1.5	2	2.5	3	3.5	4	4.5	5	5.5	6
5	2.83	3.95	5.27	6.59	7.90	9.22	10.54	11.86	13.17	14.49	15.81
7	2.12	3.18	4.24	5.30	6.35	7.42	8.48	9.54	10.60	11.66	12.72
10	1.68	2.53	3.37	4.21	5.05	5.90	6.74	7.58	8.42	9.27	10.11
15	1.30	1.95	2.59	3.24	3.89	4.54	5.19	5.84	6.49	7.13	7.78
20	1.08	1.62	2.15	2.69	3.23	3.77	4.31	4.85	5.39	5.93	6.46
25	0.93	1.40	1.87	2.33	2.80	3.27	3.73	4.20	4.67	5.13	5.60
30	0.83	1.24	1.66	2.07	2.49	2.90	3.32	3.73	4.15	4.56	4.98
40	0.69	1.03	1.38	1.72	2.07	2.41	2.76	3.10	3.45	3.79	4.13
50	0.60	0.90	1.19	1.49	1.79	2.09	2.39	2.69	2.98	3.28	3.58
60	0.53	0.80	1.06	1.33	1.59	1.86	2.12	2.39	2.65	2.92	3.18
90	0.41	0.61	0.82	1.02	1.23	1.43	1.63	1.84	2.04	2.25	2.45
120	0.34	0.51	0.68	0.85	1.02	1.19	1.36	1.53	1.70	1.87	2.04
150	0.29	0.44	0.59	0.73	0.88	1.03	1.18	1.32	1.47	1.62	1.76
180	0.26	0.39	0.52	0.65	0.78	0.91	1.04	1.18	1.31	1.44	1.57
240	0.22	0.35	0.43	0.54	0.65	0.76	0.87	0.98	1.08	1.19	1.30
300	0.19	0.28	0.38	0.47	0.56	0.65	0.75	0.85	0.94	1.03	1.13
360	0.17	0.25	0.33	0.42	0.50	0.58	0.67	0.75	0.84	0.92	1.00

County of San Diego Hydrology Manual



Rainfall Isopluvials

100 Year Rainfall Event - 6 Hours

Isopluvial (inches)

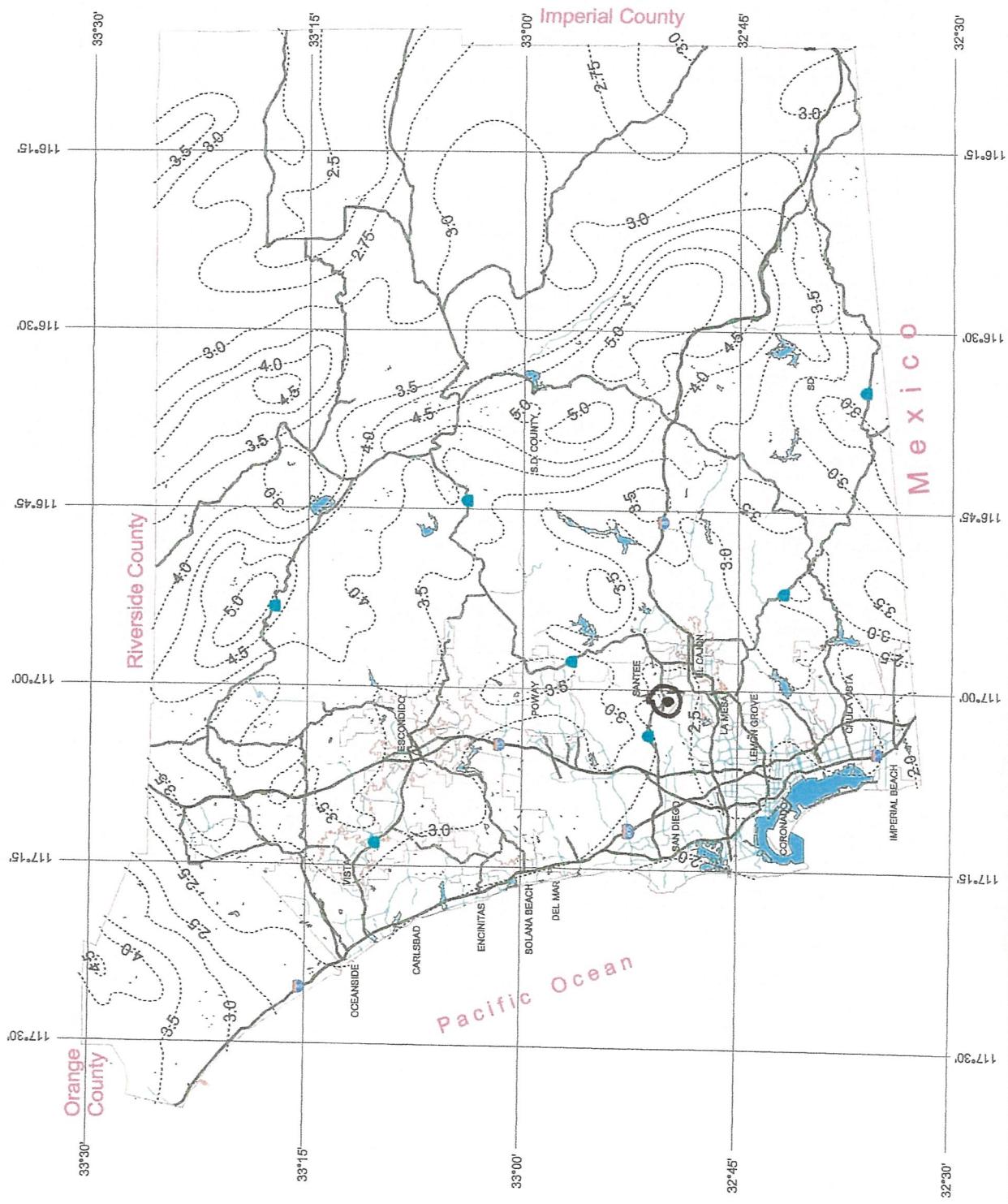


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3 0 3 Miles



Note that the Initial Time of Concentration should be reflective of the general land-use at the upstream end of a drainage basin. A single lot with an area of two or less acres does not have a significant effect where the drainage basin area is 20 to 600 acres.

Table 3-2 provides limits of the length (Maximum Length (L_M)) of sheet flow to be used in hydrology studies. Initial T_i values based on average C values for the Land Use Element are also included. These values can be used in planning and design applications as described below. Exceptions may be approved by the “Regulating Agency” when submitted with a detailed study.

Table 3-2

**MAXIMUM OVERLAND FLOW LENGTH (L_M)
& INITIAL TIME OF CONCENTRATION (T_i)**

Element*	DU/ Acre	.5%		1%		2%		3%		5%		10%	
		L_M	T_i										
Natural		50	13.2	70	12.5	85	10.9	100	10.3	100	8.7	100	6.9
LDR	1	50	12.2	70	11.5	85	10.0	100	9.5	100	8.0	100	6.4
LDR	2	50	11.3	70	10.5	85	9.2	100	8.8	100	7.4	100	5.8
LDR	2.9	50	10.7	70	10.0	85	8.8	95	8.1	100	7.0	100	5.6
MDR	4.3	50	10.2	70	9.6	80	8.1	95	7.8	100	6.7	100	5.3
MDR	7.3	50	9.2	65	8.4	80	7.4	95	7.0	100	6.0	100	4.8
MDR	10.9	50	8.7	65	7.9	80	6.9	90	6.4	100	5.7	100	4.5
MDR	14.5	50	8.2	65	7.4	80	6.5	90	6.0	100	5.4	100	4.3
HDR	24	50	6.7	65	6.1	75	5.1	90	4.9	95	4.3	100	3.5
HDR	43	50	5.3	65	4.7	75	4.0	85	3.8	95	3.4	100	2.7
N. Com		50	5.3	60	4.5	75	4.0	85	3.8	95	3.4	100	2.7
G. Com		50	4.7	60	4.1	75	3.6	85	3.4	90	2.9	100	2.4
O.P./Com		50	4.2	60	3.7	70	3.1	80	2.9	90	2.6	100	2.2
Limited I.		50	4.2	60	3.7	70	3.1	80	2.9	90	2.6	100	2.2
General I.		50	3.7	60	3.2	70	2.7	80	2.6	90	2.3	100	1.9

*See Table 3-1 for more detailed description

Table 3-1
RUNOFF COEFFICIENTS FOR URBAN AREAS

NRCS Elements	Land Use	County Elements	Runoff Coefficient "C"			
			% IMPER.	A	B	C
Undisturbed Natural Terrain (Natural)	Permanent Open Space	0*	0.20	0.25	0.30	0.35
Low Density Residential (LDR)	Residential, 1.0 DU/A or less	10	0.27	0.32	0.36	0.41
Low Density Residential (LDR)	Residential, 2.0 DU/A or less	20	0.34	0.38	0.42	0.46
Low Density Residential (LDR)	Residential, 2.9 DU/A or less	25	0.38	0.41	0.45	0.49
Medium Density Residential (MDR)	Residential, 4.3 DU/A or less	30	0.41	0.45	0.48	0.52
Medium Density Residential (MDR)	Residential, 7.3 DU/A or less	40	0.48	0.51	0.54	0.57
Medium Density Residential (MDR)	Residential, 10.9 DU/A or less	45	0.52	0.54	0.57	0.60
Medium Density Residential (MDR)	Residential, 14.5 DU/A or less	50	0.55	0.58	0.60	0.63
High Density Residential (HDR)	Residential, 24.0 DU/A or less	65	0.66	0.67	0.69	0.71
High Density Residential (HDR)	Residential, 43.0 DU/A or less	80	0.76	0.77	0.78	0.79
Commercial/Industrial (N. Com)	Neighborhood Commercial	80	0.76	0.77	0.78	0.79
Commercial/Industrial (G. Com)	General Commercial	85	0.80	0.80	0.81	0.82
Commercial/Industrial (O.P. Com)	Office Professional/Commercial	90	0.83	0.84	0.84	0.85
Commercial/Industrial (Limited I.)	Limited Industrial	90	0.83	0.84	0.84	0.85
Commercial/Industrial (General I.)	General Industrial	95	0.87	0.87	0.87	0.87

*The values associated with 0% impervious may be used for direct calculation of the runoff coefficient as described in Section 3.1.2 (representing the pervious runoff coefficient, C_p , for the soil type), or for areas that will remain undisturbed in perpetuity. Justification must be given that the area will remain natural forever (e.g., the area is located in Cleveland National Forest).

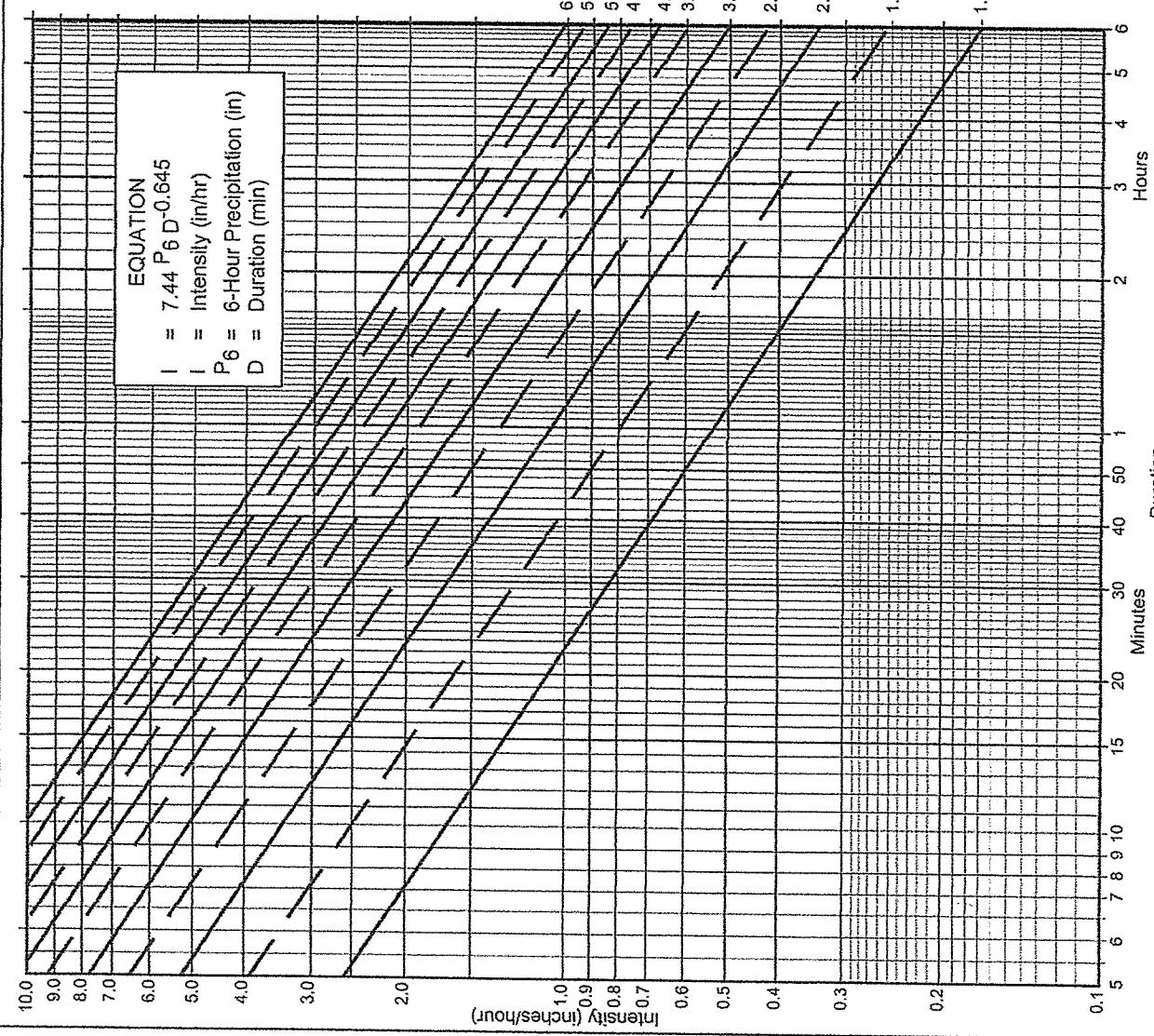
DU/A = dwelling units per acre

NRCS = National Resources Conservation Service

3-1

FIGURE

Intensity-Duration Design Chart - Template



Directions for Application:

- (1) From precipitation maps determine 6 hr and 24 hr amounts for the selected frequency. These maps are included in the County Hydrology Manual (10, 50, and 100 yr maps included in the Design and Procedure Manual).
- (2) Adjust 6 hr precipitation (if necessary) so that it is within the range of 45% to 65% of the 24 hr precipitation (not applicable to Desert).
- (3) Plot 6 hr precipitation on the right side of the chart.
- (4) Draw a line through the point parallel to the plotted lines.
- (5) This line is the intensity-duration curve for the location being analyzed.

Application Form:

- (a) Selected frequency 2 year
- (b) $P_6 = \underline{1.2}$ in., $P_{24} = \frac{P_6}{P_{24}} = \underline{1.8}$ %⁽²⁾
- (c) Adjusted $P_6^{(2)} = \underline{1.1}$ in.
- (d) $t_x = \underline{\quad}$ min.
- (e) $I = \underline{\quad}$ in./hr.

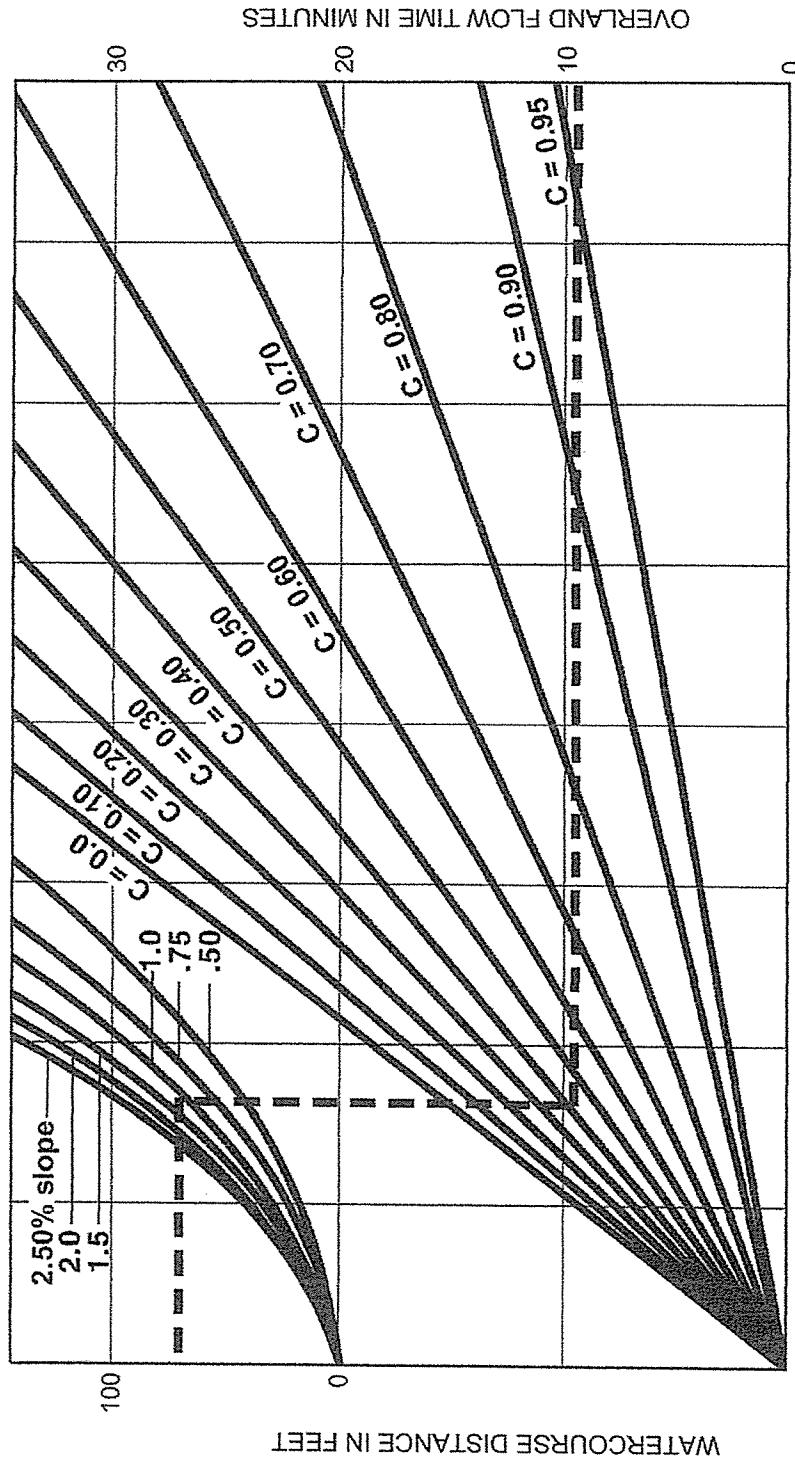
Note: This chart replaces the Intensity-Duration-Frequency curves used since 1965.

P ₆	1	1.5	2	2.5	3	3.5	4	4.5	5	5.5	6
Duration	1	1	1	1	1	1	1	1	1	1	1
5	2.63	3.95	5.27	6.59	7.90	9.22	10.54	11.86	13.17	14.49	15.81
7	2.12	3.18	4.24	5.30	6.36	7.42	8.48	9.54	10.60	11.66	12.72
10	1.68	2.53	3.37	4.21	5.05	5.90	6.74	7.58	8.42	9.27	10.11
15	1.30	1.95	2.59	3.24	3.89	4.54	5.19	5.84	6.49	7.13	7.78
20	1.08	1.62	2.15	2.69	3.23	3.77	4.31	4.85	5.39	5.93	6.46
25	0.93	1.40	1.87	2.33	2.80	3.27	3.73	4.20	4.67	5.13	5.60
30	0.83	1.24	1.66	2.07	2.49	2.90	3.32	3.73	4.15	4.56	4.98
40	0.69	1.03	1.38	1.72	2.07	2.41	2.76	3.10	3.45	3.79	4.13
50	0.60	0.90	1.19	1.49	1.79	2.09	2.39	2.69	2.98	3.28	3.58
60	0.53	0.80	1.06	1.33	1.59	1.86	2.12	2.39	2.65	2.92	3.13
90	0.41	0.61	0.82	1.02	1.23	1.43	1.63	1.84	2.04	2.25	2.45
120	0.34	0.51	0.68	0.85	1.02	1.19	1.36	1.53	1.70	1.87	2.04
150	0.29	0.44	0.59	0.73	0.88	1.03	1.18	1.32	1.47	1.62	1.76
180	0.26	0.39	0.52	0.65	0.78	0.91	1.04	1.18	1.31	1.44	1.57
240	0.22	0.33	0.45	0.54	0.65	0.76	0.87	0.98	1.08	1.19	1.30
300	0.19	0.28	0.38	0.47	0.56	0.66	0.75	0.85	0.94	1.03	1.13
360	0.17	0.25	0.33	0.42	0.50	0.58	0.67	0.75	0.84	0.92	1.00

3-3

F I G U R E

Rational Formula - Overland Time of Flow Nomograph

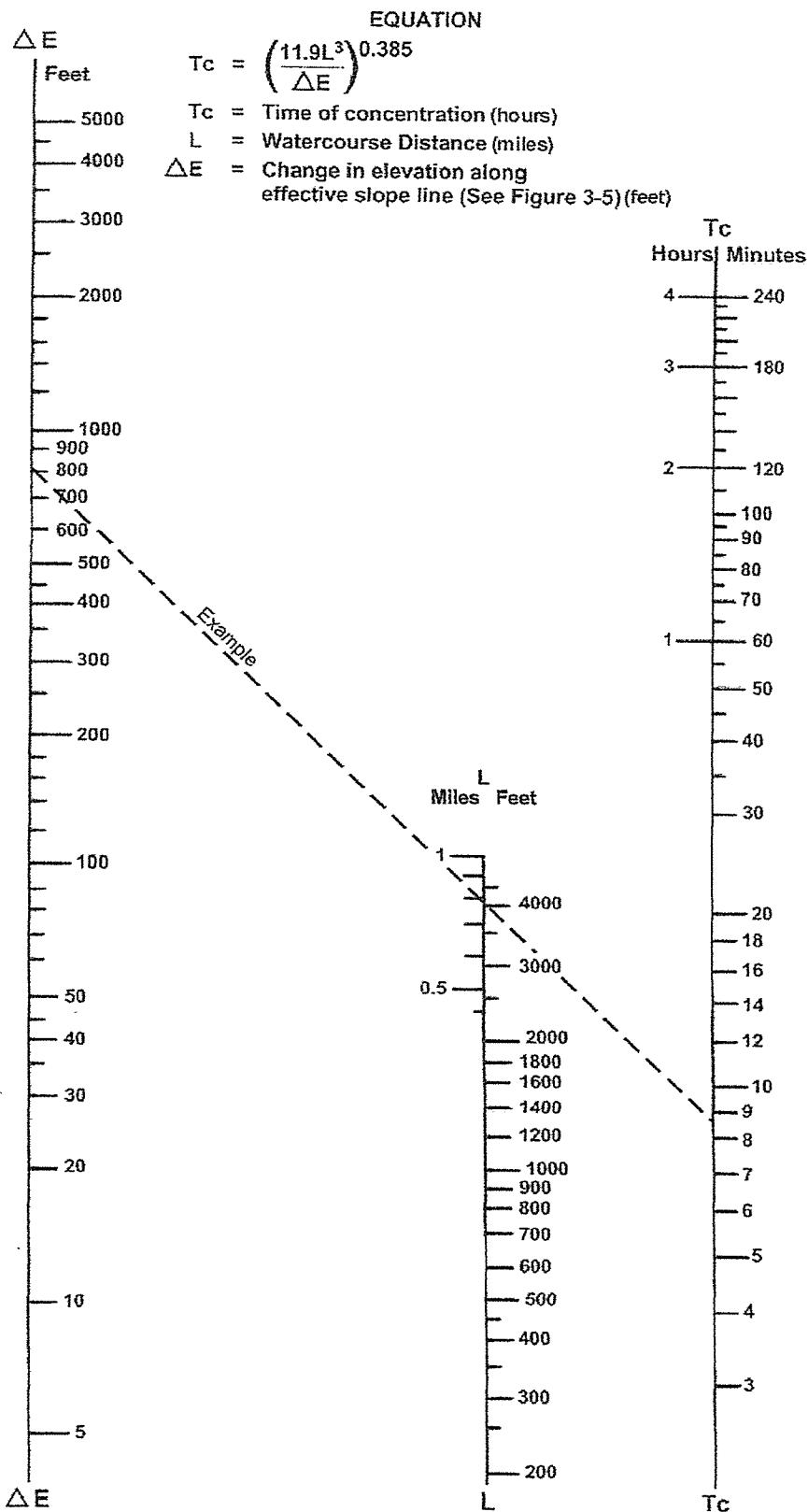


EXAMPLE:

Given: Watercourse Distance (D) = 70 Feet
 Slope (s) = 1.3%
 Runoff Coefficient (C) = 0.41
 Overland Flow Time (T) = 9.5 Minutes

SOURCE: Airport Drainage, Federal Aviation Administration, 1965

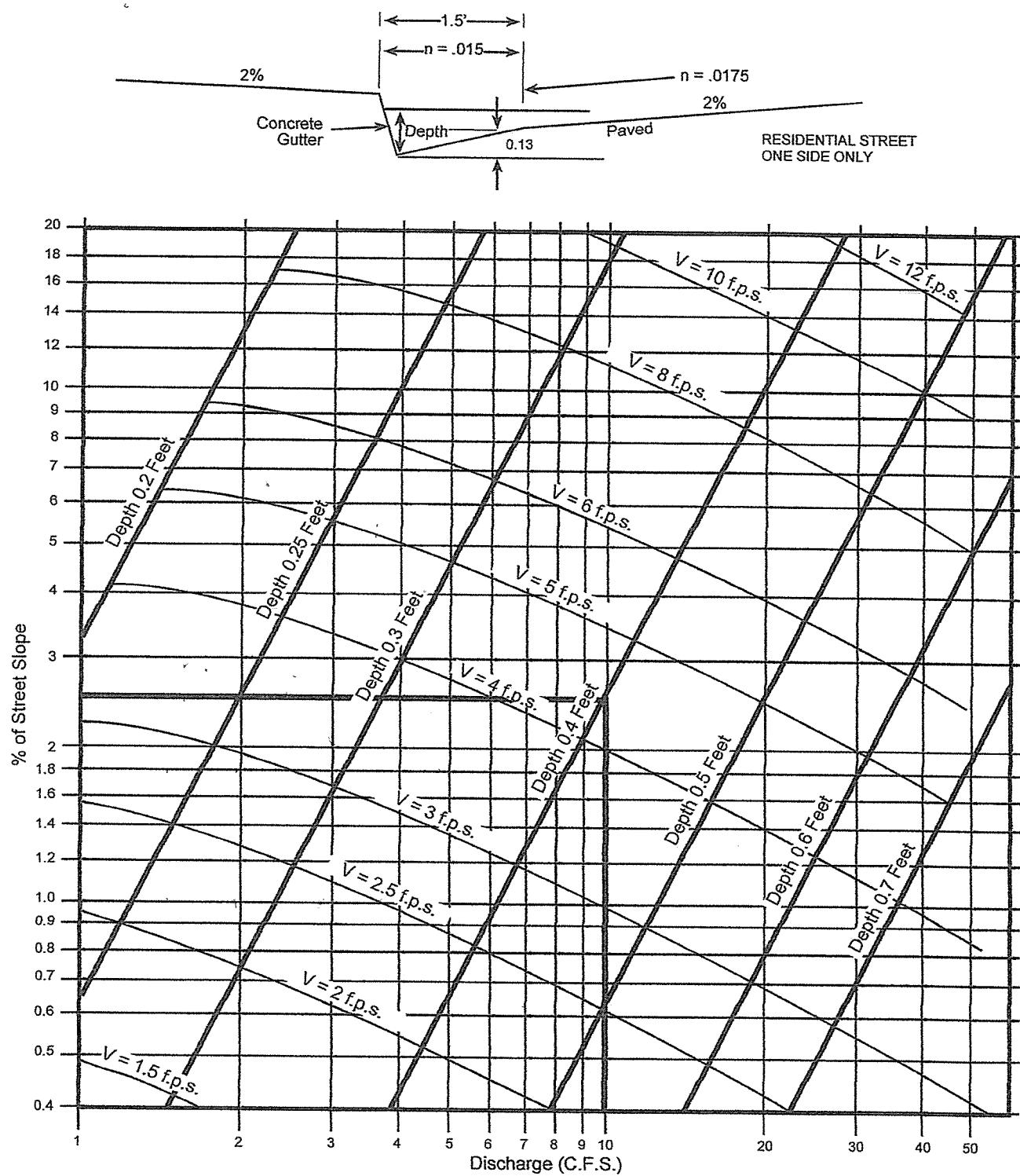
$$T = \frac{1.8 (1.1-C) \sqrt{D}}{3\sqrt{s}}$$



SOURCE: California Division of Highways (1941) and Kirpich (1940)

Nomograph for Determination of
Time of Concentration (T_c) or Travel Time (T_t) for Natural Watersheds

3-4



EXAMPLE:

Given: $Q = 10$ $S = 2.5\%$

Chart gives: Depth = 0.4, Velocity = 4.4 f.p.s.

SOURCE: San Diego County Department of Special District Services Design Manual

FIGURE

Gutter and Roadway Discharge - Velocity Chart

3-6

$4'' - Km = 1.89$

$8'' - Km = 11.78$

$10'' - Km = 14.24$

$$Q = Km(S_F)^{1/2}$$

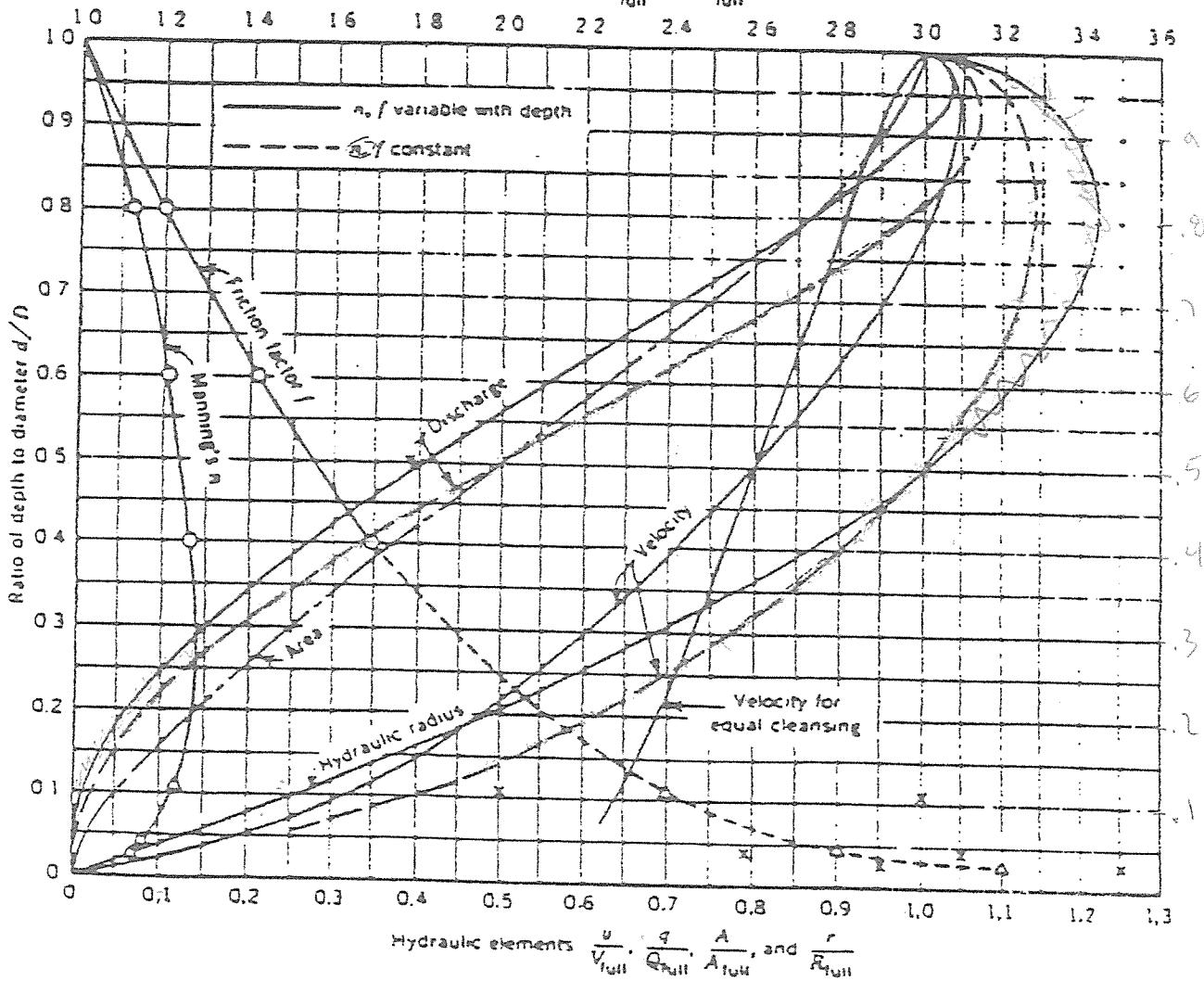
TABLE III A-1

CONVEYANCE FACTORS - R.C. PIPE OR BOX

PIPE			EQUIVALENT BOX			CONVEYANCE PIPE OR BOX K_M
AREA (sq.ft.)	DIA. (in.)	K_F for $L = 100$ ft.	H	W	A (sq.ft.)	
0.7854	12	3.126	$S_F = \left(\frac{Q}{K_M}\right)^2$	$n = .013$	$K_M = \frac{1.486}{n} (ar^{2/3})$	35.6
.227	15	2.322				64.6
1.77	18	1.821				105
2.41	21	1.483				158
3.14	24	1.241				226
3.98	27	1.060				310
4.91	30	.921				410
5.94	33	.8115				529
7.07	36	.7226				666
8.30	39	.6495				825
9.62	42	.5883				1006
11.04	45	.5366				1209
12.57	48	.4924	4'-0"	3'-4"	13.34	1436
14.19	51	.4542	4'-3"	3'-7"	15.06	1690
15.90	54	.4208	4'-6"	3'-9"	16.87	1965
17.72	57	.3916	4'-9"	4'-0"	18.80	2273
19.63	60	.3657	5'-0"	4'-2"	20.83	2604
21.65	63	.3426	5'-3"	4'-4"	22.98	2964
23.76	66	.3220	5'-6"	4'-7"	25.21	3357
25.97	69	.3035	5'-9"	4'-10"	27.55	3782
28.27	72	.2868	6'-0"	5'-0"	30.00	4234
30.68	75	.2716	6'-3"	5'-3"	32.55	4720
33.18	78	.2577	6'-6"	5'-5"	35.21	5242
35.79	81	.2451	6'-9"	5'-8"	37.97	5796
38.49	84	.2335	7'-0"	5'-10"	40.83	6388
41.28	87	.2228	7'-3"	6'-1"	43.80	7012
44.18	90	.2130	7'-6"	6'-3"	46.87	7676
47.17	93	.2039	7'-9"	6'-6"	50.05	8380
50.27	96	.1954	8'-0"	6'-8"	53.34	9119
53.46	99	.1876	8'-3"	6'-11"	56.31	9899
56.75	102	.1802	8'-6"	7'-1"	60.21	10719
60.13	105	.1734	8'-9"	7'-4"	63.34	11582
63.62	108	.1670	9'-0"	7'-6"	67.50	12486
67.20	111	.1610	9'-3"	7'-9"	70.88	13427
70.88	114	.1554	9'-6"	7'-11"	75.21	14427
74.66	117	.1501	9'-9"	8'-2"	78.83	15457
78.54	120	.1451	10'-0"	8'-4"	83.33	16537
82.52	123	.1404	10'-3"	8'-7"	87.11	17649
86.59	126	.1360	10'-6"	8'-9"	91.87	18856
90.76	129	.1318	10'-9"	9'-0"	95.89	20065
95.03	132	.1278	11'-0"	9'-2"	100.83	21324
99.40	135	.1240	11'-3"	9'-5"	105.06	22634
103.87	138	.1204	11'-6"	9'-7"	110.21	24032
108.43	141	.1170	11'-9"	9'-10"	114.61	25434
113.10	144	.1138	12'-0"	10'-0"	120.00	26891

APPENDIX 5

Values of $\frac{f}{f_{full}}$ and $\frac{R}{R_{full}}$



v = Actual velocity of flow (fps)

A = Area occupied by flow (ft^2)

v_{full} = Velocity flowing full (fps)

A_{full} = Area of pipe (ft^2)

q = Actual quantity of flow (cfs)

r = Actual hydraulic radius (ft.)

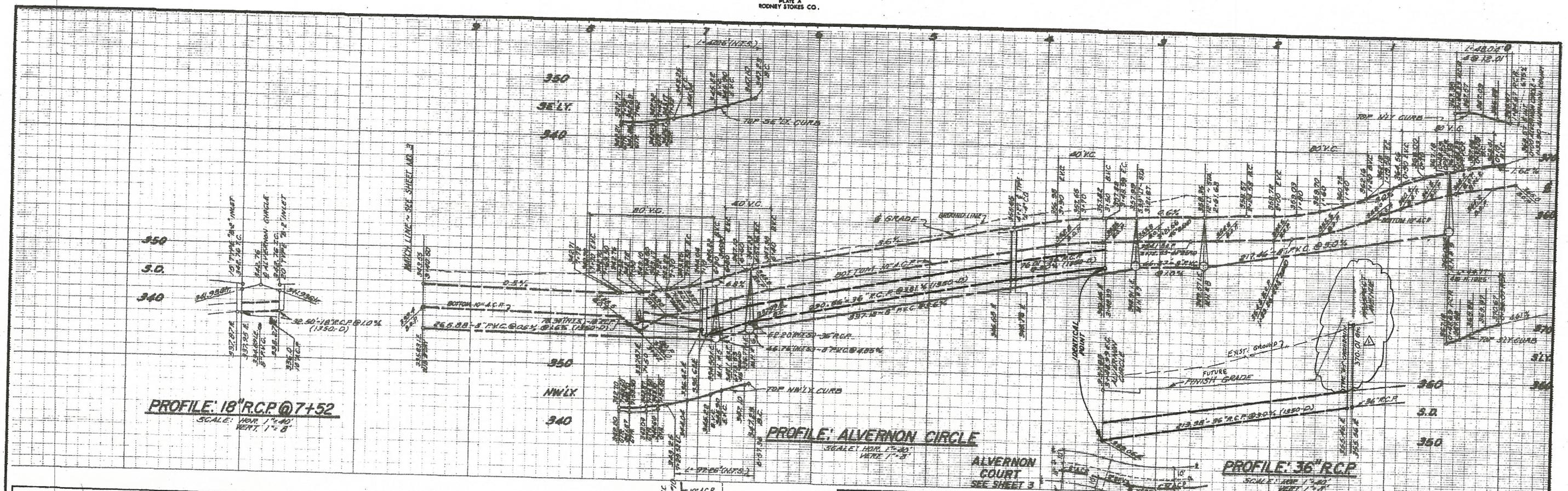
Q_{full} = Capacity flowing full (cfs)

R_{full} = Hydraulic radius of full pipe (ft.)

Fig. II-3. Hydraulic Elements Chart

APPENDIX 4

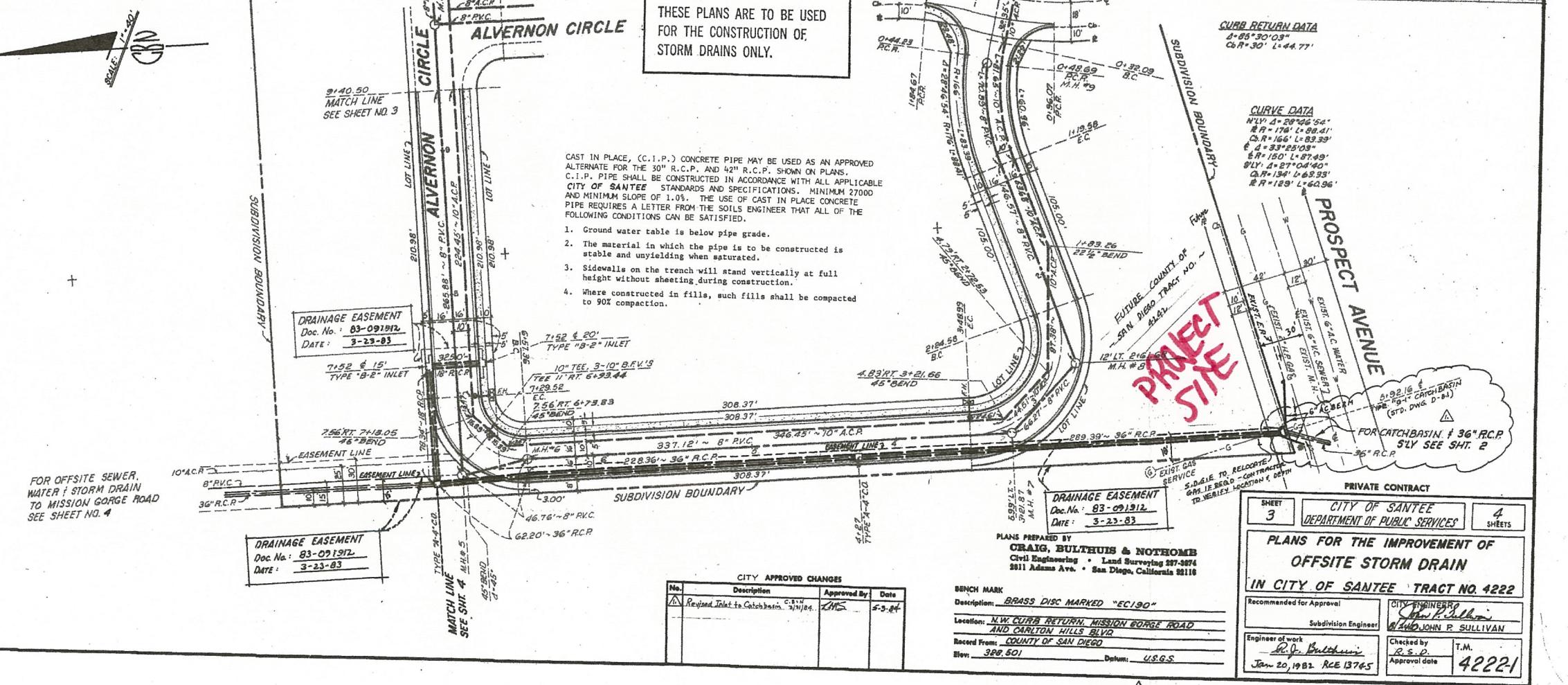
HYDROMODIFICATION EXHIBIT



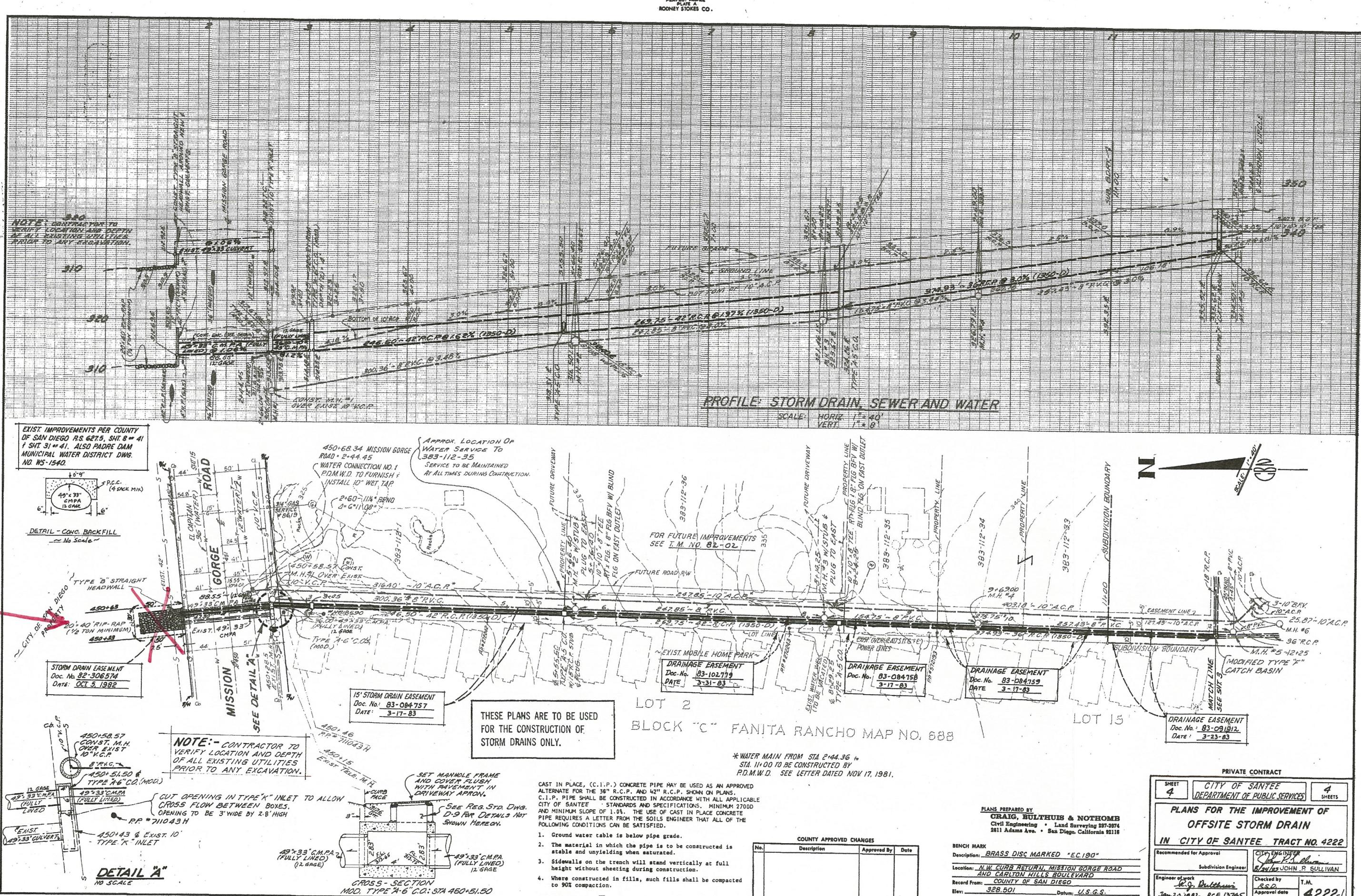
SEWER & WATER LATERAL DATA TABLE							
LOT NO.	MAIN	TOMAIN	LENGTH	SEWER ELEV.	CB.ELEV.	DEPTH	REMARKS
1	366.2	"	26'	372.5	371.38	5'	SEWER LAT IN DRIVE
2	366.9	"	26'	369.2	374.2	5'	374.40
3	368.6	"	26'	371.6	376.6	5'	376.30
4	370.9	"	26'	374.5	379.5	5'	379.78
5	372.7	"	26'	374.8	381.8	5'	381.52
6	374.6	"	26'	379.1	384.1	5'	384.43
7	375.4	"	26'	380.1	385.1	5'	384.81
8	377.2	"	26'	382.1	387.1	5'	387.30
9	377.7	"	26'	382.6	387.6	5'	387.35
10	379.4	"	25'	384.2	389.5	5'	389.42
11	379.9	"	18'	385.1	390.1	5'	389.90
12	379.9	"	27'	386.2	391.2	5'	391.33
13	379.9	"	44'	386.2	391.2	5'	391.20
14	379.9	0.3'	47'	386.0	391.0	5'	391.23
15	379.9	"	66'	384.6	389.6	5'	389.40
16	378.1	"	70'	383.9	388.9	5'	389.16
17	375.9	"	31'	380.5	385.5	5'	385.52
18	372.8	"	26'	376.9	381.9	5'	382.24
19	370.7	"	26'	374.2	379.2	5'	378.88
20	368.5	"	26'	371.4	376.4	5'	376.96
21	366.8	"	26'	369.0	374.0	5'	373.73
22	"	42'	368.9	373.9	5'	373.77	
23	"	"	369.0	374.0	5'	374.42	

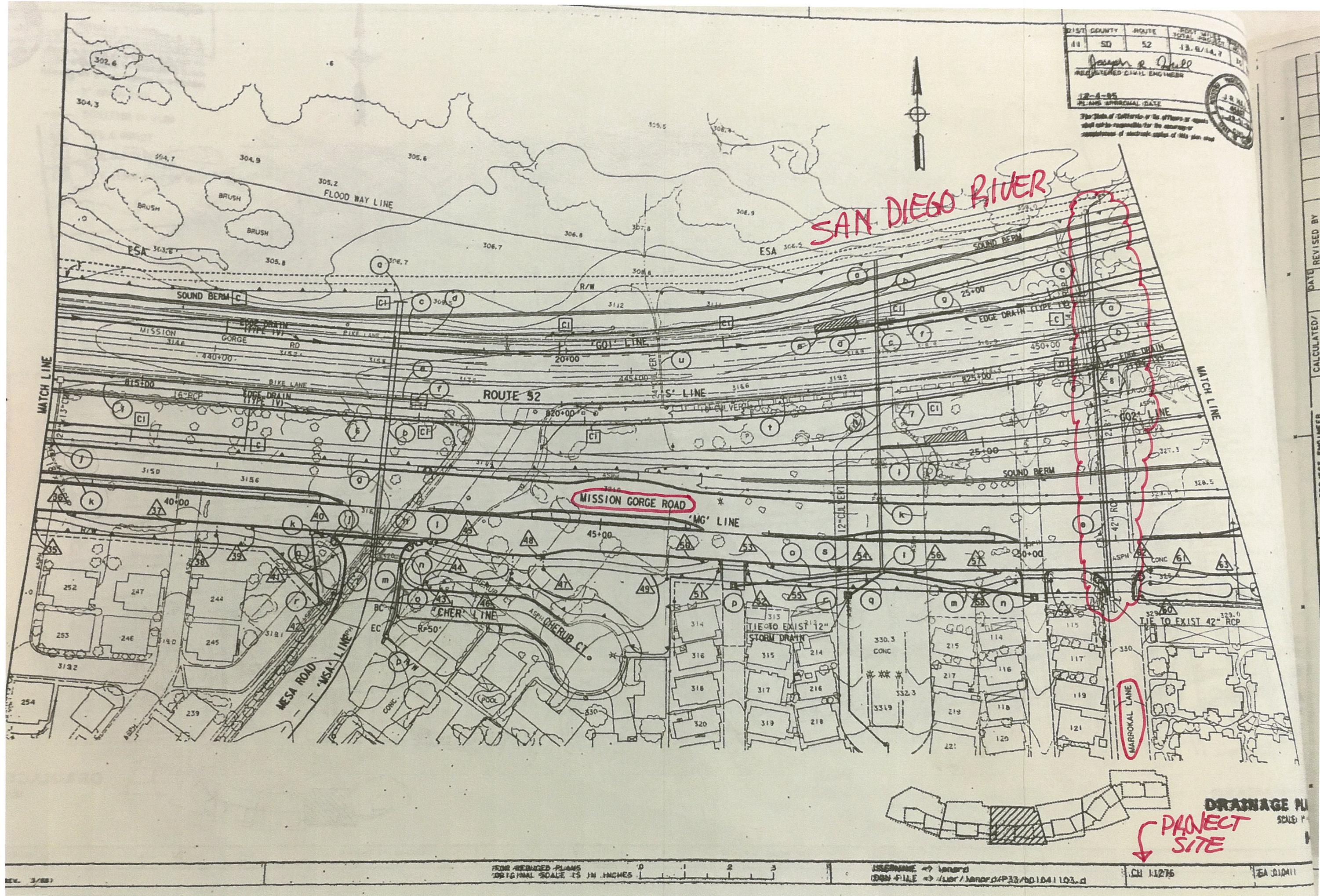
FOR OFFSITE SEWER,
WATER & STORM DRAIN
TO MISSION GORGE ROAD
SEE SHEET NO. 4

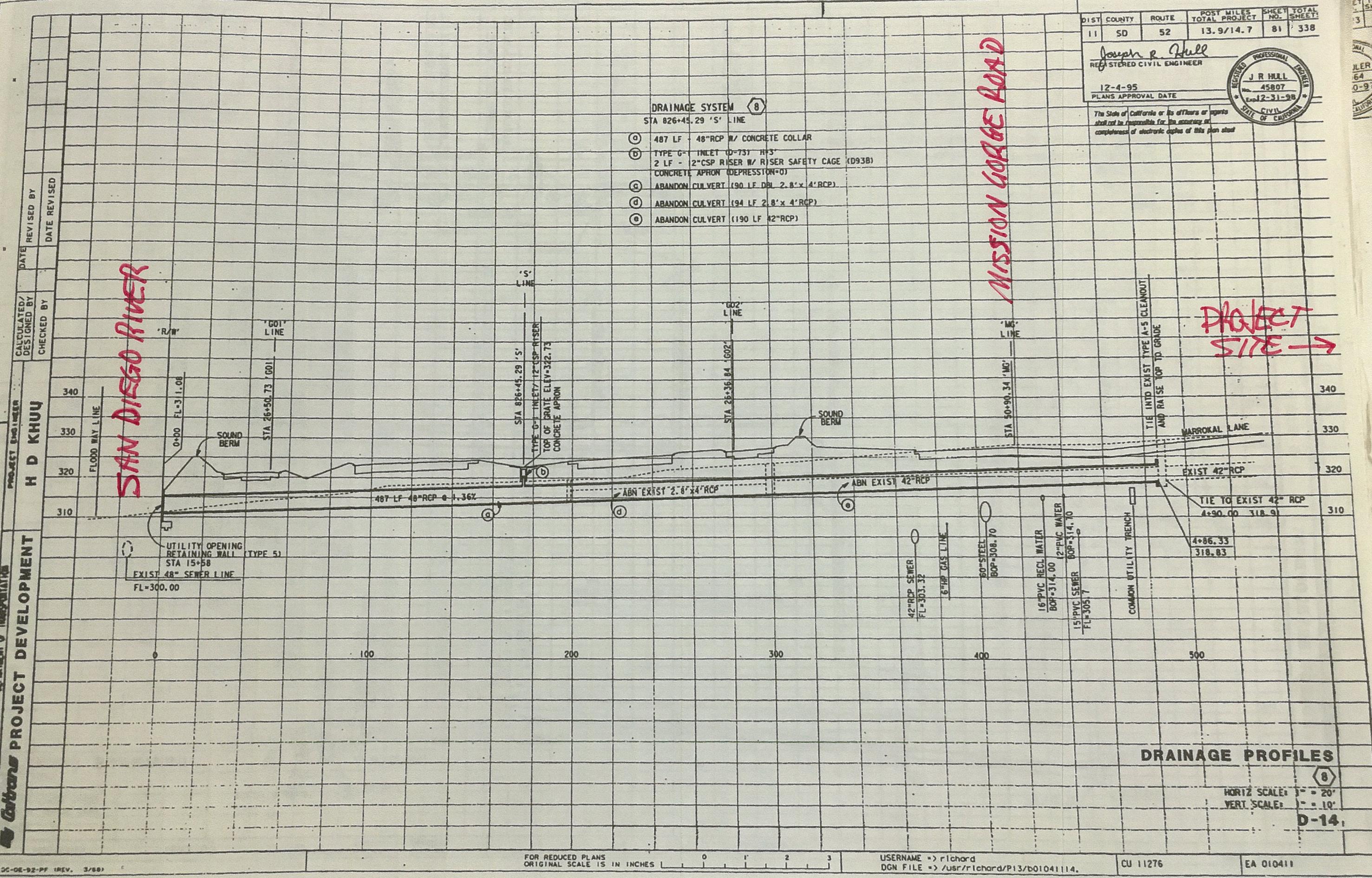
DRAINAGE EASEMENT
Doc. No.: 83-091912
DATE: 3-23-83



**SEE CATCH DRAINS ONLY
FOR CONTINUATION**



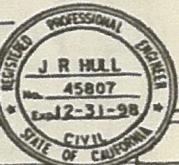




DIST	COUNTY	ROUTE	POST MILES	SHET NO.	TOTAL SHEET
11	SD	52	13.9/14.7	81	338

Joseph R. Hull
REGISTERED CIVIL ENGINEER

12-4-95
PLANS APPROVAL DATE



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ET TOTAL SHEET:
3 331
JLR 64
0-97
CIVIL ENGINEERING &
CALIFORNIA

FIGURE 2
EXISTING CONDITION HYDROLOGY
PROSPECT ESTATES PHASE 2

MAY 26, 2017

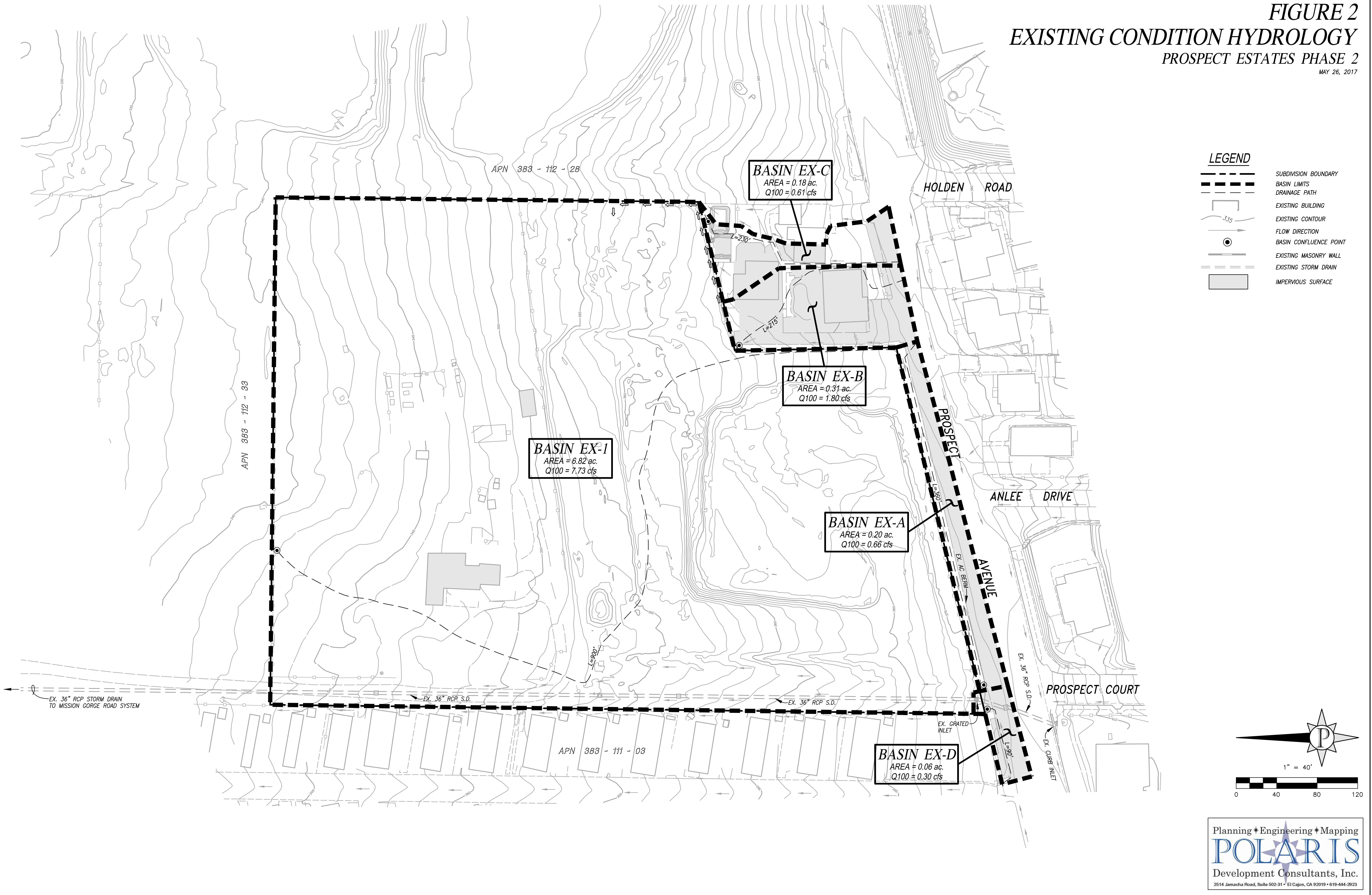


FIGURE 3
PROPOSED CONDITION HYDROLOGY
PROSPECT ESTATES PHASE 2

JANUARY 22, 2018

